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RADICULITIS[1]

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THE subject is not particularly new, as Bechterew over thirty years ago described a syndrome which he ascribed to a pachymeningitis and compression of the spinal nerve roots, the symptoms consisting essentially of a stiff spine, nerve root pains, nerve root degeneration, alterations of sensation, and muscle atrophies of a radicular distribution. The neurologic side of this condition is usually overlooked, rarely emphasized, and never sufficiently credited as important in textbooks and medical literature.

Radiculitis may be described as an acute inflammation of the spinal nerve roots, manifested by alterations of sensation or in changes in muscle function, which show by their distribution that the primary disease process is in the spinal root and not in the tracts and nuclei of the cord or in a peripheral nerve trunk. Dejerine considered syphilis and tuberculosis the most common causes. Spinal osteo-arthritis as a cause of radiculitis received little attention.

A root type of altered sensation or a changed motor power is not distinctive in itself, because many diseases of the spine may produce similar symptoms.

Nathan has shown experimentally that radiculitis may result from osteo-arthritis of the spine and is due to involvement of the nerve root, either from meningeal reaction secondary to the osteo-arthritic process or from pressure in narrowed canals. The French writers consider this condition clinically as rheumatic radiculitis, neurodocitis, funicular radiculitis. In discussing nerve syndromes and osteo-arthritis of the spine as causes of sciatica, lumbago, also cervical, brachial, and intercostal neuralgias, Bassoe called attention to the appalling lack of objective observations.

In this presentation radiculitis shall be construed as an involvement of the spinal nerve roots whether intra- or extra-meningeal, or the intervertebral neurodocitis of Sicard.

The spinal nerves are joined to the spinal cord by their dorsal and ventral roots, which are frayed-out bundles of axons, called the "fila radicularia," at their lines of attachment to the cord. The fila radicularia and the short intra-meningeal portions of the roots are called by Sicard the "radicular nerve," while the extra-meningeal portion is called the "funicular nerve." The dorsal root contains the spinal ganglion, which is closely invested by the dura mater but is largely outside its cavity. Although the roots pierce the dura separately, they are enclosed in a single tubular sheath of dura, which includes the spinal ganglion and posterior root, making their passage through the intervertebral foramen in this form.

[1]Read before the Radiological Society of North America, at the Eighteenth Annual Meeting, at Atlantic City, Nov. 28–Dec. 1, 1932.

Fig. 1. Right oblique projection of the lumbar spine. Note changes on the fourth and fifth lumbar bodies.

The ganglia of the last lumbar and first four sacral nerves lie inside the vertebral canal, but outside the dural sac, while the ganglia of the last sacral and coccygeal nerves lie not only inside the vertebral canal, but inside the dural sac. The two roots leave the intervertebral foramen together as a short trunk which soon breaks up into branches, which in certain regions furnish the elements making up the plexus. The dura is separated from the periosteum and the wall of the intervertebral canal by a very small interval, containing thin-walled plexiform veins and loose fatty tissue.

Sicard used the term "neurodocha" to designate the bony canal through which the spinal roots pass to reach their foramina of exit. A pathologic process within the intervertebral canal he called a "neurodocitis" and involvement of the short extra-meningeal spinal root (the funiculite), he termed a "funiculitis." Sensory alterations (or changes in motor power), dependent on a pathologic process in a given nerve root, will be manifested at the periphery as a radicular disturbance regardless of whether or not the part involved is intra- or extra-meningeal.

The spinal roots vary in size. The largest form the nerve trunks of the limbs, namely, the lower cervical and first thoracic roots and the lumbar and sacral roots. Of these, the ones for the lower limbs are the larger. All the thoracic nerves except the first are small.

The sixth cervical root is the largest of the cervical nerves; these roots diminish in size from below upward. The size of the nerve root in relation to the canal is of definite importance in determining the liability of mechanical irritation. It has been found that, beginning with the fifth lumbar root, from below upward, the size of the nerve decreases in relative proportion to the size of the foramen; namely, for their size, the fifth lumbar roots have the smallest canals, frequently almost filling them, while it is rare that the fourth lumbar roots completely fill the openings.

With respect to the size of individual roots, the posterior are larger than the anterior. They contain a greater number of radicular fibers and the individual fibers are larger. In the cervical region, the posterior roots are three times larger than the anterior, except in the case of the first cervical, which is always smaller, and, in rare cases, absent.

The composition of the intervertebral canal and the relations of the roots in this canal are of some importance. The roots are in relation, above and below, respectively, to the inferior and the superior intervertebral notches of the adjacent vertebræ; in front, with some of the posterior part of the bodies and with a portion of the intervertebral disk separating them, and behind, the posterior articulation. The superior posterior articular facet reaches upward toward the inferior intevertebral notch of the body above, and, on movements of extension, it

approaches the nerve root in the canal and further decreases the size of the intervertebral foramen.

Nathan called attention to the inflammatory nature of the pathologic process in spondylitis deformans and he concluded that subjective and objective sensory alterations of a radicular nature should be present, depending in degree on the severity of the paradicular exudation. The intensity and permanence of these symptoms depended on the fibrosis subsequent to repair after the inflammatory process had subsided. He thought the persistence of neurologic symptoms and signs was due to a mechanical disturbance in the spinal canal and in the intervertebral foramen, secondary to these sequelæ.

Parker and Adson, in a series of cases with nerve root and cord symptoms, subjected to exploratory laminectomy, found that the hypertrophic process may be extensive without roentgenologic evidence of its presence. They, too, concluded that the process was inflammatory, with infection and trauma as the prominent factors. The former they considered to be the more common and prominent cause of the disease and the latter the predisposing factor, which continued the process through mechanical irritation. Patrick stressed the occurrence of low grade fever and leukocytosis in osteo-arthritic processes.

As previously stated, the greatest care in appraising the value and cause of radicular pain is necessary to rule out cord lesions. Also, it is sometimes difficult and occasionally impossible to rule out a visceral disease; in fact, it occasionally happens that hypertrophic spondylitis and true visceral disease may exist concurrently and it is apparent that a true differential diagnosis is impossible.

There seems to be some difference of opinion as to the existence of true visceral pain, but the contention seems to be that the pain is referred to superficial and parietal

Fig. 2. Left oblique projection. Compare with Figure 1 and note the contour of the fourth body.

structures by the cerebrospinal nerves belonging to the spinal segments to which the splanchnic nerves of the involved organs run.

A common explanation of referred pain is that the afferent impulses from the irritated tissue, on reaching the central nervous system, spread the adjacent sensory centers and so excite these that painful impulses from them reach consciousness and are interpreted by the brain as coming from the peripheral distribution of such nerves. Thus when one has an inflamed tooth, pain may be felt not only in the tooth, but also on the side of the face or in the ear. This is clear when we are dealing with the somatic nerves, but the same explanation is used when the afferent impulses must pass through the voluntary nerves and then spread and excite adjacent cerebrospinal cells. Thus in the case of irritation of the gall bladder, pain may be felt in the parietes supplied by the eighth dorsal nerves; in angina pectoris, in the distribution of the first to the fourth dorsal nerves, and so on.

The usual symptoms in the order of fre-

Fig. 3. Anteroposterior projection of the lumbar spine, showing marked spur formation on the second and third lumbar bodies, on their left sides, which is the convexity of a lateral curvature. Note the aberrant articulation between the right malformed fourth transverse process and the superior surface of the superior articular facet of the fourth lumbar vertebra. This area also shows evidences of hypertrophic changes.

quency are: pain, aching, soreness, stiffness, paresthesia (burning, numbness, tingling, heaviness, weight, feeling of constriction), dizziness, cramps, and tenderness. Pain is described as sharp, shooting, gnawing, catching, dull, pinching, twinging, piercing and the like, in various ways, according to the manner of expression of the patient. The outstanding symptoms according to frequency are: pain, aching, soreness, and stiffness. Age incidence of hypertrophic osteo-arthritis of the spine covers a wide range. It is not necessarily an accompaniment of old age, as it may exist from the middle thirties to the seventies. It occurs more frequently in men, probably because they are subject to trauma. If present and a trauma occurs, a confusion may arise in litigation as to the question of divided liability, because of possible exacerbation of symptoms. Also, as previously stated, no pronounced x-ray findings may be present, and the symptoms, nevertheless, may be severe; conversely, many hypertrophic x-ray findings may exist without any symptoms.

Therefore, reliance must be placed on the subjective symptoms and, in combining these with a good neurologic and roentgenologic survey, a reasonably certain and accurate diagnosis can be made, always bearing in mind the possible presence of a true visceral organic lesion, because of simulation.

It might appear that undue attention has been called to the question of pain and nerve distribution; therefore, before leaving this subject, the writer is desirous of recalling to you the presence of communicating branches between the sympathetic nerves and spinal nerves; he is of the conviction that in hypertrophic spondylitis there appears to be some possibility that the sympathetic nervous system is indirectly involved, with a consequent alteration in function of the structures supplied by these nerves.

The basis of this paper is the following report of a case that has been under observation for about fourteen years. The patient is a male, aged 51 years, with a relevant history as follows: Typhoid forty years previous to the present examination; streptococcic sore throat sixteen years ago. The patient has noticed a gradual loss of general well-being since the throat infection.

The areas involved are named in sequential order, also the accompanying symptoms of prominence.

1. *Right acromio-clavicular articulation.*—Two years' duration; relieved by extraction of one devitalized, symptomless tooth. Hypertrophic changes present on the adjoining parts of the acromion process and clavicle.

2. *Thumb.*—Peri-articular involvement of the dorsal portion of the interphalangeal joint of the left thumb. Recovery was of six years' duration and slow. No bone changes.

Fig. 4. Oblique projection.

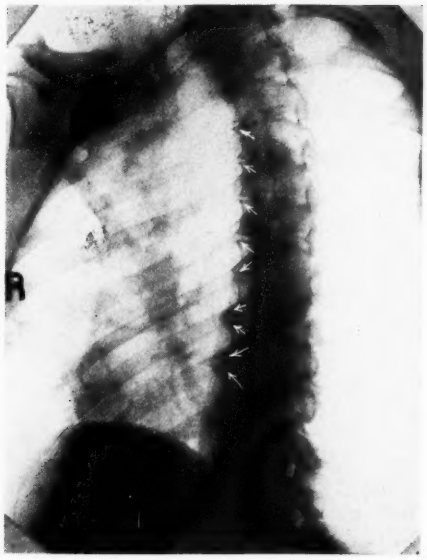

Fig. 5. Oblique projection of dorsal spine, showing marked hypertrophic changes.

3. *Tendon of the inner hamstring.*—Slight hypertrophic changes of the right knee joint; 11 years' duration, and not completely well; occasional severe attacks at present.

4. *Right metatarso-phalangeal joint.*—Some changes present; started about 11 years before present examination; was painful for several years; symptomless at present.

5. *Fourth lumbar vertebra.*—Marked changes on the fourth lumbar body; slight changes on the fifth lumbar body and adjoining portion of the sacrum. Pain seemed to be reflected to prostate and rectum. These structures were negative to palpation and inspection; 12 years' duration; symptomless at present.

6. *Second and third lumbar vertebræ.*—Spurs on the left side of the second and third lumbar bodies. Radicular symptoms present on the left side; feeling of constriction in left inguinal region and upper thigh, particularly along the anterior surface, also numbness and tingling of left calf and foot.

7. *Mid- and lower dorsal vertebræ.*—Marked changes on lower two-thirds of dorsal spine; radicular symptoms simulated duodenal ulcer, gall-bladder disease, and pylorospasm; also marked spasticity of colon. Upon exercise, fainting spells would occur which brought relief of the abdominal pains, giving the patient a feeling of intra-abdominal comfort but a mental attitude of impending collapse and faintness. This was probably due to irritation of the splanchnic nerves. There also occurred a spasticity of the colon so marked at one time that practically none of the opaque meal passed beyond the distal two-thirds of the transverse colon, simulating a carcinoma. However, mineral oil and rest produced relaxation of this constriction, with definite findings which ruled out a malignancy.

8. *Cervical.*—Slight changes on fifth and sixth cervical vertebræ; ringing in ears, occipital pain, slight pain in region of thyroid. Extraction of three non-devitalized teeth relieved this entirely.

Fig. 6. One film of complete gastro-intestinal series (32 hours), taken postero-anteriorly. Shows high degree of stasis proximal to the arrow; distal to this, the colon was gas-distended and only small amounts of the opaque meal passed beyond the apparent constriction, which proved to be a spasm.

9. *Pseudo-arthrosis between the right fourth altered transverse process and the upper portion of the fifth articular facet.*—Feeling of constriction over right lower quadrant and upper thigh; duration seven months; at present almost well. It was found by repeated trials that a moderate amount of exercise was most satisfactory; that the backache was made worse by undue exercise and that, when this happened, the radicular symptoms became worse.

In conclusion, it is vital to state that a vaccine has been the chief remedial measure. The bacteria in this case were obtained from the fecal contents and were strains of *Streptococcus hemolyticus* and *viridans*. Marked improvement has been achieved after three years of diligent use of this vaccine.

SUMMARY

General Remarks.—Cause or causes of hypertrophic spondylitis may be senescence, trauma, infection, or metabolic.

Its incidence is high—more in the male. The age incidence is from the middle thirties to the seventies; usually painful in the earlier decades. Radiculitis occurs frequently. An added injury complicates the condition.

Special Features of this Case.—Multiple joint and tendon involvement; the major spur formation is on the convex side of the curvature, toward the left, with left-sided lower abdominal symptoms. After exercise, symptoms of pylorospasm and spastic colon are present; also attacks of faintness occur. Both of these are probably reflex involvement of the sympathetic, the latter due to sudden dilatation of the abdominal blood vessels.

THE COMPARATIVE VALUE OF THE SEROLOGIC AND ROENTGENOLOGIC DIAGNOSES OF CONGENITAL SYPHILIS[1]

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THE time to diagnose congenital syphilis is immediately after birth, hence the importance of the development of accurate methods which will establish beyond a question of doubt the presence of syphilitic infection in the newborn. The clinical aspects of syphilis have changed considerably in the last 25 years. It is rare that one encounters in hospital practice fully developed, clinical syphilis. The general rule is that there is very little clinical indication of syphilis. Furthermore, clinicians rarely make exhaustive searches for the presence of syphilis. The great majority rely upon the examination of the blood or spinal fluid, or both. In congenital syphilis, unless one is aware that the mother has syphilis, and unless definite evidence of syphilis is present in the newborn, such as skin lesions, etc., the detection of syphilis has, up to recent times, depended entirely upon examination of the blood. Lately, the roentgenologic diagnosis of syphilitic involvement of the osseous system has been developed to a high degree of accuracy. The diagnosis of congenital syphilis by serologic methods applied to the cord blood has had varying degrees of success, and there is a general opinion among many obstetricians that the examination of the cord blood is not very accurate. It is important to emphasize now that, in reviewing the literature, one must pay careful attention to the methods employed for the serologic diagnosis of syphilis.

In Mount Sinai Hospital, a complement fixation test, the Kahn test, and Kline's micro-precipitation test have been used routinely. A description of the technic and the results obtained on cases other than obstetric has been reported from this laboratory (1). The same tests were applied to maternal blood and blood obtained from the cord at delivery. In a few cases, blood was taken from the fontanel. In all instances of positive serology, re-checks were made on blood obtained from the fontanel. Cord blood is very apt to be antecomplementary, according to Kolmer (2), yet in about one thousand examinations we have had no antecomplementary reactions, and we attribute this to the technic used in obtaining the blood. As soon as the child has been delivered, the cord is wiped dry with a sterile sponge, cut through with sterile scissors which have not been used for any other purpose during the course of the delivery, and the blood allowed to drip freely into a test tube. The tube is immediately corked and sent to the laboratory. We feel that, if the tests are carried out properly—and it must be remembered that these tests for syphilis are highly technical and must be done with great care—the results have a very high degree of accuracy. Furthermore, it is our opinion that, if similar tests serve to diagnose acquired syphilis without clinical manifestations, they should be equally applicable to the blood of mothers and newborn infants.

Our series is admittedly small, yet it has been carefully studied clinically, serologically, and roentgenologically. We have not had a single instance of a false positive in the mother's blood or the cord blood. Of very striking significance is the fact that not one of these patients with positive findings

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gave any evidence of clinical syphilis. Not one of the babies had any skin lesions, and, were it not for the routine examination of the blood, the presence of syphilis would have gone undetected. Syphilis was known to have been present in some of the mothers, but, at the time the blood was taken, there was no evidence of it, and a great many would never have been suspected of being infected were it not for this routine examination.

In discussing the accuracy of the complement fixation test in the diagnosis of syphilis during pregnancy, Kolmer (2) states:

"Pregnancy does not give biologically false positive reactions, and the danger is not from falsely positive reactions but from falsely negative reactions. Negative complement fixation tests and precipitation tests alone are never absolutely trustworthy in ruling out syphilis in pregnant women, hence the importance of re-checks in suspected cases."

He also says:

"In children born with the obvious acute skin and mucous membrane lesions of syphilis, the reaction is positive in practically 100 per cent, but in children born of syphilitic mothers without manifest lesions, and tested a month or two after delivery, positive reactions are observed in approximately from 70 to 80 per cent. A small percentage of these react negatively when tested immediately or within the first week after birth. The child of a positive mother may react positively during the first week or two after birth, and then give a negative reaction. Some physicians are of the opinion that the temporarily positive reaction is due to the transfer of antibodies from the mother to the child, without the latter being syphilitic, but I believe that this is a very risky assumption, and prefer to regard the child as potentially syphilitic, and would urge that this child be kept under close observation and checked at intervals of three months."

We examined serologically 1,096 mothers and 974 infants. In 122 infants we were unable to obtain cord blood. In either the mother or the infant findings were positive in 30 cases. Both maternal and cord blood were positive in 13 cases. In all of the latter we were able to get positive re-checks or clinical corroboration from the physician or from the past history. Of the 13 infants, seven were examined roentgenologically shortly after birth. One was re-examined serologically and roentgenologically about one year later. In one case we were unable to make a roentgenologic examination at birth, but we were able to do so six months afterward.

In 17 cases we had positive serologic findings in maternal blood, but negative findings in the cord blood. In this series, we obtained five roentgenologic examinations immediately after birth, and four, several months after birth. We subsequently discovered that the mothers had been treated for syphilis or that the reaction remained positive several months after delivery. The interpretation of the negative serologic findings in these 17 cases of maternally positive but infant negative results is somewhat unsatisfactory in view of our failure to get a sufficient number of the infants re-checked. We were able to re-check only four infants serologically, and the tests were negative several months after birth. Inquiry has not disclosed that any of these infants have developed any clinical signs of syphilis. So, while we are unable to state definitely that these infants did not develop manifestations of syphilis, or that their blood was persistently negative, we can point out that not all children of syphilitic mothers are necessarily infected, or at least not all of them manifest the presence of syphilis at or shortly after birth. This merely emphasizes that infants with a heritage of syphilis should be very carefully and closely observed and re-examined at frequent intervals.

A comparison between the roentgenologic and the serologic examinations of the newborn is the point of importance in this paper. Positive indications of osseous syphilis with-

in the first week of life were discovered in six babies. Of these, the mother's blood was positive in all, the baby's blood was not examined in one, and the cord blood was positive in four and negative in one. X-ray examinations were negative at birth in seven instances. Of these seven cases, the mother and baby were positive in three, and the mother positive and the baby negative in four. Six cases were examined, three at intervals of six, seven, and ten months, and three cases after one year. Of these six cases, three gave positive roentgenologic findings. In the latter, two were positive serologically and one positive maternally, but the cord blood was negative. The other three cases gave negative roentgenologic findings. In these babies the blood was negative, while the mothers' blood was positive. In one of the instances in which the roentgenographic examination after one year was positive for osseous syphilis, the x-ray examination at birth had been negative, and both mother and baby were positive serologically. In other words, there was positive agreement at birth between the roentgenologic findings and the serologic findings in five cases. The roentgenologic findings were positive in one case in which the blood was negative, and negative in three in which both the baby's blood and the maternal blood were positive. The x-ray findings agreed with the negative cord blood in seven. Positive findings of osseous syphilis were detected in one instance examined one year after birth, in which case the cord blood was negative, the re-check on the baby negative, and the maternal blood positive.

In the search for lesions of a syphilitic nature in the osseous system, three cases resembling exostoses were discovered, all bilateral, which involved the humeri. They were located at the junction of the distal and middle fourths of the bone. These cases gave positive evidence of syphilis of the bones; serologically they were positive in both mother and baby. A fourth case of exostosis of one clavicle was discovered; the mother and baby were negative serologically and there was no evidence of osseous syphilis in the baby. We are unable definitely to relate these exostoses to the syphilis, but, in view of their occurrence, particularly as bilateral lesions and at the site of tendon traction, the possibility of their being the result of syphilitic proliferation must be considered.

A careful reading of McLean's (3) excellent and most comprehensive work on congenital osseous syphilis is necessary in order that the roentgenologist may understand that "thorough clinical study and serologic examinations" play an important part in diagnosis. This statement refers particularly to osseous lesions of the newborn, in infants examined immediately after birth.

A vast amount of work has been done on osseous syphilis by European investigators. During the years, pathologic controversies have arisen. American effort in the direction of solving some of these problems was rather late in making its appearance. Curtis Smith (4), late in 1872, reported on congenital dactylitis syphilitica. McLean gives this work credit for being the first "discoverable" report on the subject. Then appeared R. W. Taylor's (5) work, published in 1875, which antedates, of course, the use of roentgen rays and the Wassermann examination. Taylor recognized the fact that, when syphilis and rickets were present in the same patient, it was not to be inferred that the syphilis was the cause of the rickets. He also was aware of the fact that epiphyseal separations could be recognized clinically. At the present time, it is rather generally agreed that the lesions of acquired syphilis in children simulate those of the adult. It must be understood, however, that congenital syphilis, as manifested in lesions of bone, is an entirely different matter. It is this latter manifestation that concerns us

and which prompted our note on the cases that have come under our personal observation.

The outstanding work of Wimberger (6) offers to the radiologist the first principle in connection with congenital syphilis. His division of congenital syphilis as it affected osseous structure was:

1. Fetal syphilis
2. Nursling syphilis
3. Recidive, or period of relapse up to about the fourth year
4. Syphilis tarda—beyond the fourth year

Osseous syphilis may be detected as early as the fifth or sixth month of intra-uterine life. In the first few months of extra-uterine life, the maximum changes can be observed. They become less manifest after the sixth month. In the second and third years of life, the bone lesions take on the characteristics of acquired syphilis. Evidently, after the sixth month, the diagnosis of osseous congenital syphilis without serologic and clinical aid becomes increasingly difficult. Wimberger (6) and McLean (3) appear to agree on the difficulty in recognizing early or minimal lesions. Our study of a few cases seems to corroborate this fact in the newborn.

McLean lists the following types of lesions found in the first months of life, upon which he says a diagnosis may be made upon roentgenologic evidence alone:

1. Well defined saw-tooth metaphyses in well calcified bones.
2. Deep zones of submetaphyseal rarefaction.
3. Bilateral symmetrical osteomyelitis of the proximal mesial aspects of the tibiæ.
4. Multiple separation of epiphyses, with or without impaction in bones which are not rachitic.
5. Multiple circumscribed osteomyelitis of the long bones, shown by the roentgen rays as patchy areas of rarefaction.
6. Multiple longitudinal areas of rarefaction (osteomyelitis) in the shafts of the long bones, sometimes resulting in fractures.
7. Destructive lesions at the mesial or lateral aspects of the metaphyses (foci of rarefaction).
8. Multiple areas of cortical destruction generally seen within a centimeter of the ends of the bones.
9. Double zone of rarefaction at ends of bones.
10. Localized periosteal cloaking occurring in more than one bone.

These ten points are perfectly illustrated in McLean's (3) article, but we would like to impress upon you that their recognition in the newborn is not always possible. To be sure, the technical difficulties are many, and the interpretation requires skill and experience. Realizing our own lack of experience, it was thought best not to rely strictly on our own interpretation. We therefore obtained the generous co-operation of Dr. Helen Jane Zillmer,[2] a former pupil of Wimberger. We submitted our films to her with the results shown, which in the main corroborated our general contention, namely, that osseous lesions of congenital syphilis do exist. It is, however, one thing to find them in a patient a month or two after birth, but quite another matter to be able to detect minimal lesions, even if present, in the infant a day or a week old.

In this connection, the following report (7), made in 1927, may be of interest. The youngest patient treated was a colored male, one week old, with a positive Wassermann, in whom there was clinical evidence of syphilis but negative x-ray findings.

Again, Shipley, Pearson, Weech, and Greene (8) reported in 1921 that every syphilitic infant does not show roentgenologic evidence of the disease.

By no means do we wish to infer that the

[2]We are indebted to Dr. H. J. Zillmer and Mr. Samuel Grauman for their generous co-operation.

CHART I.—ROENTGENOLOGIC EVIDENCE NEGATIVE FOR SYPHILIS

Number of case	Baby's serology	Maternal serology	Time of x-ray examination	Osseous lesions
1	Positive	Positive	At birth	....
2	Positive	Positive	At birth	....
3*	Positive	Positive	At birth	....
4	Negative	Positive	Ten months	....
5	Negative	Positive	Seven months	....
6	Negative	Positive	One year	....
7	Negative	Positive	At birth	....
8	Negative	Positive	At birth	....
9	Negative	Positive	At birth	....
10	Negative	Positive	At birth	....

*See Case 4 in Chart II.

CHART II.—ROENTGENOLOGIC EVIDENCE POSITIVE FOR SYPHILIS

Number of case	Baby's serology	Maternal serology	Time of x-ray examination	Osseous lesions
1	Positive	Positive	At birth	Periosteal changes in distal portion of humerus
2	Positive	Positive	At birth	Submetaphyseal rarefaction of femur
3	Positive	Positive	At birth	Submetaphyseal rarefaction of femur
4*	Positive	Positive	One year	Rarefaction in pelvis
5	Positive	Positive	At birth	Submetaphyseal rarefaction in femur, radius, and humerus
6	Positive	Positive	Six months	Periostitis of humerus
7	Not taken	Positive	At birth	Submetaphyseal lesions of humerus and femur
8	Negative	Positive	One year	Periosteal lesion of tibia
9	Negative	Positive	At birth	Periosteal lesion of humerus, femur and radius

*See Case 3 in Chart I.

x-ray examination of infants is an unnecessary procedure. On the contrary, we are of the opinion that it is indispensable, but it must be checked serologically in the presence of positive or negative findings. All suspected cases should be kept under observation for from four to six months.

It has been shown (8) that "while a positive Wassermann is still regarded as almost certain proof of syphilis, a negative reaction until after the fourth month may not indicate the absence of the disease. Clinical diagnosis of syphilis in an infant may be difficult because symptoms may be lacking, and because a mother, free from any indications of disease, may give birth to a syphilitic infant."

SUMMARY

Serologic examination of mothers and babies at, or shortly after, delivery should be adopted as a routine procedure. In the presence of positive serologic findings in either the mother or the baby, roentgenologic examination of the osseous system of the baby should be made. Positive serologic findings in mother and baby, or in the baby alone, should be considered as indicative of syphilis until proved otherwise by follow-up studies. The roentgenologic examination of such infants will establish lesions of the osseous system in a great percentage of cases. Negative roentgenologic findings should not be considered as contradictory evidence of the presence of syphilis; they merely indicate the absence of osseous syphilis at birth. Roentgenologic evidence of osseous syphilis may be obtained in the absence of positive serologic findings in the baby. All instances of positive maternal blood and negative cord

blood serve to emphasize the importance of re-checking the serologic and roentgenologic examinations at intervals of from three to six months. Negative cord serology and negative roentgenologic findings in the presence of maternal syphilis are not absolute evidences of the absence of syphilis in the newborn. If they are bilateral, exostoses may be of syphilitic origin.

REFERENCES

(1) Enzer, Norbert, Hallman, G. V. (Mrs.), Conway, E. A., and Hyslop, L.: A Comparison of the Diagnostic Value of the Wassermann, Kahn, and Micro-precipitation Tests for Syphilis. Ann. Int. Med., February, 1931, IV, 1028-1035.

(2) Kolmer, J. A.: Serum Diagnosis by Complement Fixation, with Special Reference to Syphilis: the Principles, Technic, and Clinical Applications. Lea and Febiger, Philadelphia, 1928.

(3) McLean, Stafford: Roentgenographic and Pathologic Aspects of Congenital Osseous Syphilis. Am. Jour. Dis. Child., January, 1931, XLI, 130-152.
Idem: Correlation of Roentgenographic and Pathologic Aspects of Congenital Osseous Syphilis, with Particular Reference to First Months of Life. Am. Jour. Dis. Child., February, 1931, XLI, 363-395.
Idem: Correlation of Roentgenologic Picture with Gross and Microscopic Examination of Pathologic Material in Congenital Osseous Syphilis. Am. Jour. Dis. Child., March, 1931, XLI, 607-675.
Idem: Correlation of Clinical Picture with Osseous Lesions of Congenital Syphilis as Shown by X-rays. Am. Jour. Dis. Child., April, 1931, XLI, 887; May, 1931, XLI, 1128.
Idem: Osseous Lesions of Congenital Syphilis; Summary and Conclusions in 102 Cases. Am. Jour. Dis. Child., June, 1931, XLI, 1411-1418.

(4) Smith, Curtis: A Case of Congenital Dactylitis Syphilitica. Am. Jour. Syph. and Dermat., 1872, III, 33.

(5) Taylor, R. W.: Syphilitic Lesions of the Osseous System. William Wood and Company, New York, 1875.

(6) Wimberger, H.: Klinische-radiologische Diagnosis von Rachitis, Scorbut, und Lues congenita. Ergebn. d. inn. Med. u. Kinderh., 1925, XXVIII, 264.

(7) Lindsay, J. W., Rice, E. C., and Selinger, M. A.: Bone Changes in Congenital Syphilis. Am. Jour. Syph., 1927, XI, 118.

(8) Shipley, P. G., Pearson, J. W., Weech, A. A., and Greene, C. H.: X-ray Pictures of the Bones in the Diagnosis of Syphilis in the Fetus and in Young Infants. Bull. Johns Hopkins Hosp., 1921, XXXII, 75.

DISCUSSION

Dr. Charles F. Geschickter (Baltimore): Having followed exostosis of all sorts for the past five years, this is the first time I have seen it presented in newborn infants.

Although we know exostosis is an hereditary sort of multiple lesion, following through families, hereditary through either the father or mother, we rarely see it in the newborn, not because it does not show up later, but it rarely is shown by the x-ray at that time.

On the other hand, we get exostoses of the same type at the point of muscle attachment after trauma, or we can see them exaggerated after trauma.

We get exostosis in adults after the age of 14, due to gonorrhea: all are acquainted with the gonorrheal occurrence. Dr. Enzer shows us that congenital syphilis will produce an exostosis which may be seen in the roentgenograms; I think also a split muscular attachment in the newborn. That is interesting though it will not be appreciated for many generations, but what we are proving is that cancer has not one cause but many causes. The tumors are fundamentally in the tissues and the exciting causes that can be incident—I know of no better place to illustrate that than in exostoses. We know they can be hereditary and come after trauma. Dr. Enzer shows them in the newborn in congenital syphilis and we can show them in the adult in gonorrhea.

I am particularly glad to see this unique and, I think, new presentation of syphilis producing exostosis in the newborn.

Dr. Podlasky (closing): The case showing exostoses on the clavicle was that of a patient who is not reported with the material gathered for this paper. The pediatrician felt the sharp projection above the right clavicle. Several attempts were made to get the baby into the proper position before we obtained evidence of exostosis.

I am rather ashamed of the fact that I cannot show a great many of the early lesions of

bone syphilis. I, of course, refer to the detection of these lesions in newborn infants a day or two old. It is difficult to obtain good films of minimal lesions. It is not only difficult to obtain good roentgenograms, but much more so to reproduce these slight changes on lantern slides. We are just beginning this work and hope to improve our technic sufficiently to be able to reproduce some of these early changes.

In reference to syphilis as the cause of exostosis, a word of caution is perhaps opportune. We do not wish to infer that we are convinced that the type of exostoses shown is definitely related to, or caused by, syphilis. These cases are merely shown as interesting findings. It is, perhaps, significant that, in three cases which showed involvement of the humeri, the exostoses were bilateral. In the clavicle case we had a negative serology, both of the baby and its parents. The other three were positive.

At a meeting of this Society in Toronto, I presented over a thousand infants. We have added many more since then in our study of the thymus gland. This is the first time I have had occasion to observe this type of exostosis in the newborn.

THE ROENTGENOLOGIC STUDY OF THE THORACIC AORTA[1]

By SAMUEL BROWN, M.D., CINCINNATI, OHIO
From the Roentgenological Departments of the General and Jewish Hospitals

A STUDY of a large number of chests by the radiologic method has resulted in the following conclusion: While the size, shape, and position of the heart and aorta vary according to the age, height, weight, habitus, position of the diaphragm, and the position of the body as a whole, the relation of the heart and aorta to their neighboring structures remains constant under normal conditions and inconstant under abnormal conditions. That being the case, it is self-evident that a knowledge of the relationship of the intrathoracic structures is of greater value in enabling one to recognize an abnormal change in the heart and aorta than the dependence upon a knowledge of the shape, size, and position, which are variable even under normal conditions.

The anterior and lateral positions of the chest were chosen as a basis for the study of the relationship of the intrathoracic structures. The oblique position, though useful at times in demonstrating a lesion to greater advantage, has been found to be subject to too many possible variations to serve as a basis for study. It has also been found that the distance factor between the tube and film is not of great importance, since the relationship remains the same no matter what the distance may be. However, teleoroentgenograms were taken in the great majority of the cases.

THE AORTA IN THE ANTERIOR POSITION

In the anterior position of the chest (Fig. 1-*A*) the thoracic aorta is almost entirely obscured by the dense structures in front and behind it. Its visualization is, therefore, difficult. However, one may indirectly obtain valuable information by studying the relation of the aorta to the spine and sternum. Thus, under normal conditions, the right border of the great blood vessel shadow does not extend beyond the sternal or vertebral border; if it does, it is to a slight degree only, but never beyond the right border of the heart shadow, from which it is separated by a notch. The left border of the great blood vessel shadow is more or less uneven and gradually extends further to the left in its course from above downward until it joins the border of the

[1]Read before the Radiological Society of North America, at the Seventeenth Annual Meeting, St. Louis, Nov. 30–Dec. 4, 1931.

left auricle, from which it is separated by a small indentation.

The great blood vessel shadow, which includes the vena cava superior on the right, the ascending aorta in the middle, and pulmonary artery on the left, makes up a more or less homogeneous shadow in which the individual blood vessels cannot be differentiated with ease. However, it was frequently possible to differentiate the blood vessels fluoroscopically and to determine the exact position of the respective vessels. It was found, under normal conditions, that the ascending aorta, which is situated between the vena cava superior and the pulmonary artery, never takes part in forming any of the borders of the great blood vessel shadow. The vena cava superior invariably forms the right border of the shadow, varying but little in its outline. The pulmonary artery forms the left border of the shadow, but, unlike the vena cava, it is more variable in its outline. This is especially true in the case of children and young adults in whom the bulging of the pulmonary artery may be quite marked, but without clinical or physical signs of any disease of the heart or blood vessels.

The arch of the aorta, which is shown in the anterior position, is only a foreshortened shadow and not a true picture. This is due to the fact that the course of the arch, being in the anteroposterior direction, consequently becomes foreshortened in the anteroposterior position. The left border of the arch is formed by the aortic semicircle, which will be called the left aortic semicircle in contradistinction to the right aortic semicircle. No attention has been paid in the past to the right semicircle, but it is, in my opinion, of equal importance to the left aortic semicircle. By means of a contrast medium in the esophagus, one can readily visualize the right semicircle by the depression which the arch produces in the esophagus (Fig. 4-*A*). Under normal conditions the depression is slight, but, when the arch is dilated, the depression and displacement of the esophagus to the right may be found to be quite marked. It is also possible to determine the position of the right border of the arch by noting the position of the left border of the trachea, which lies on the right side of the arch of the aorta and generally corresponds to the midsternal line. Thus, if measurement of the arch is desired, it should be made between the left border of the trachea or esophagus and the most prominent point of the left semicircle, which lies a little to the left of the sternal border.

The descending aorta is but little seen in the anterior position. Occasionally the left border may be seen for a short distance below the aortic knob.

THE AORTA IN THE LATERAL POSITION

In the lateral position of the chest (Fig. 1-*B*), the entire thoracic aorta may be seen from its origin to its termination. This is especially true in individuals beyond middle age (Fig. 2-*B*). The ascending aorta is located anteriorly and its ventral border is continuous with the ventral border of the heart. In individuals beyond middle age, a line of demarcation is seen between the heart and aorta (Figs. 2-*B* and 3-*B*). The course of the ascending aorta is upward and backward, producing a transparent triangle due to lung tissue between the aorta and the anterior chest wall. The size and transparency of this triangle depend upon the degree of inspiration. The deeper the inspiration, the more transparent and greater is the triangle. It has, therefore, been the rule to take the roentgenograms upon deep inspiration. The dorsal border of the ascending aorta is less distinct on account of the left auricle and right pulmonary artery, which lie behind it, and from which it cannot be distinguished unless the wall is atheromatous. Above, the ascending aorta is continuous with the arch, the course of which is from before backward and is best studied in the lateral position (Figs. 1-*B*, 2-*B*. and

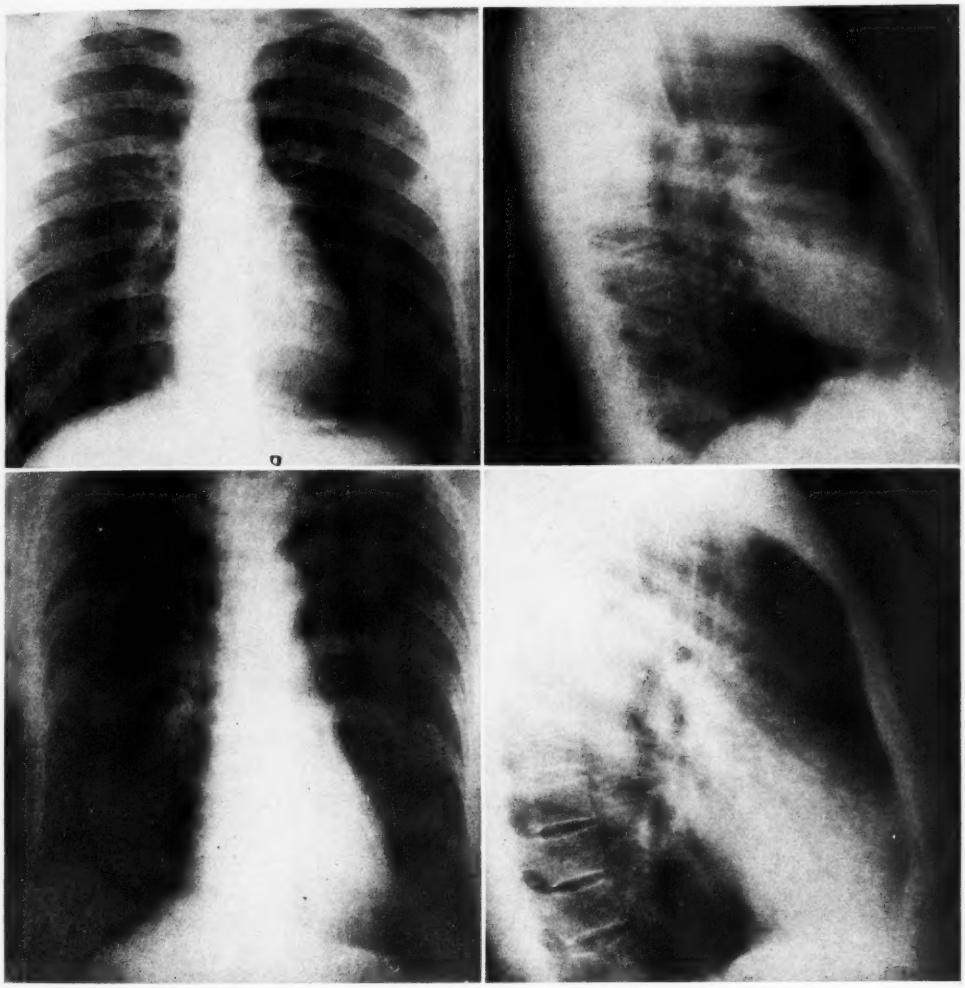

Fig. 1-*A (upper left).* The right border of the great blood vessel shadow does not project beyond the sternal border and is separated from the right border of the heart by a notch. The left border consists of two convex arcs, the aortic knob and pulmonary artery.

Fig. 1-*B (upper right).* The heart occupies the anterior half of the thorax. A triangular clear space separates the aorta from the sternum. The descending aorta is anterior to the spine.

Fig. 2-*A (lower left).* The aortic semicircle projects only slightly beyond the left sternal border.

Fig. 2-*B (lower right).* The entire aorta is clearly visible. Between the heart and ascending aorta there is the notch often seen in older individuals.

3-*B*). Posteriorly, the arch is continuous with the descending aorta. The convex upper border is regular in outline, of a high degree of convexity, and does not extend beyond an imaginary line drawn from the lower point of the body of the fourth dorsal vertebra to the junction of the manubrium and the gladiolus. The lower border of the arch, which is concave, forms the upper boundary of the aortic loop. Below the aortic arch and parallel with it a lesser arch is seen, due to the left pulmonary artery (Fig. 3-*B*). Both of these arches are crossed by the lower end of the trachea in front (Fig. 3-*B*) and the esophagus behind (Fig. 4-*B*). Below the lower end of the

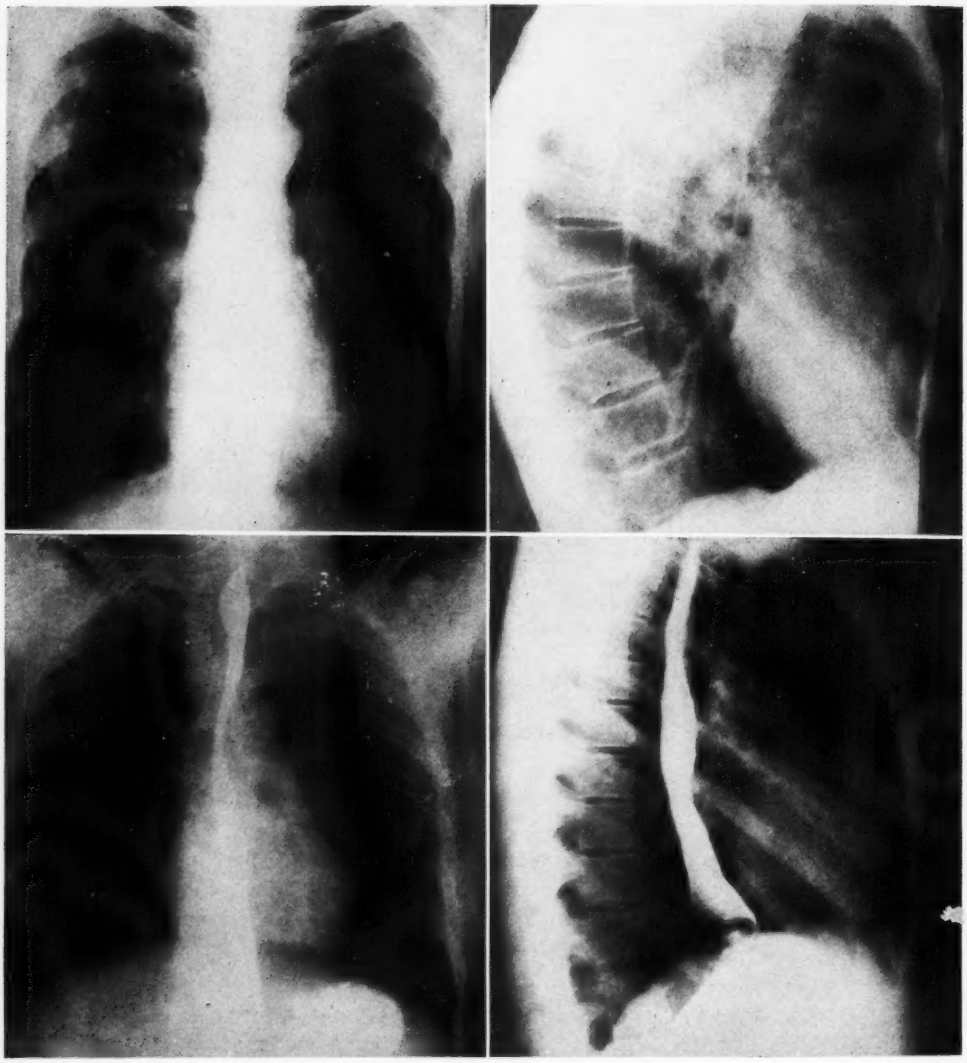

Fig. 3-*A (upper left).* The clear space separating the aorta from the anterior chest wall cannot be seen in the anterior position.

Fig. 3-*B (upper right).* In emphysema, the transparent triangle is enlarged. The notch between the heart and aorta is quite distinct. The aortic arch and the lesser pulmonary arch are distinct. The trachea crosses the arch about its center.

Fig. 4-*A (lower left).* The trachea and esophagus lie on the right side of the arch. The compression of the esophagus indicates the right semicircle.

Fig. 4-*B (lower right).* The esophagus lies behind the trachea and heart. Between the esophagus and spine is the descending aorta.

trachea a ring-like shadow is often seen, due to the origin of the major bronchi. This shadow serves as an indicator of the position of the base of the heart, since the bronchi lie just above the left auricle. The descending aorta lies directly in front and parallel to the dorsal spine. Above, its anterior border forms the posterior boundary of the aortic loop. The latter is, relatively speaking, transparent on account of the

lower end of the trachea, which contains air. The walls of the descending aorta are parallel through its whole extent. Between the descending aorta and posterior border of the heart lies the esophagus, which separates the heart from the vessel. Under no circumstance does the heart encroach upon the aorta under normal conditions, nor does the esophagus lie against the spine.

The thoracic aorta is subject to only a few diseases, such as acute and chronic aortitis (which may be specific or nonspecific in nature), arteriosclerosis, and aneurysms. The chief pathologic manifestation in any of these diseases is dilatation of the aorta, with or without arteriosclerotic changes. Radiologically, the abnormal changes of the aorta may be recognized by a disturbance in the relationship between the vessel and the surrounding structures, by an increase in density of the aortic shadow, and by circumscribed shadows communicating with the vessel. Fluoroscopically one may observe abnormal pulsations in the aorta. A detailed description of the above changes is given.

1. Displacement of the right border of the great blood vessel shadow to the right.
2. Elongation of the aorta.
3. Dislocation of the aorta.
4. Elevation of the aortic arch.
5. Depression of the aortic arch.
6. Increased radius of the arch.
7. Increased prominence of the aortic knob.
8. Double aortic semicircle.
9. Increased opacity of the aorta.
10. Change in the shape of the aorta.
11. Change in the parallelism of the aortic walls.
12. Change in the contour of the vessel walls.
13. Presence of calcareous deposits in the walls of the aorta.
14. Alteration in the position of the neighboring structures.
15. Obliteration of the anterior transparent triangle.
16. Obliteration of the aortic loop.
17. Circumscribed dense shadows along the course of the aorta.
18. Displacement of the heart.
19. Cardiac disease.
20. Alteration in aortic pulsations.
21. Abnormal changes in the bones of the thoracic cage.

1. Displacement of the right border of the great blood vessel shadow beyond the sternal border generally indicates dilatation of the ascending aorta (Fig. 5-*A*). When the right border extends further to the right than the right border of the heart, it is absolutely certain that definite dilatation of the ascending aorta exists (Fig. 6-*A*). Descent of the notch, which separates the right border of the great blood vessel shadow from the right border of the heart shadow, indicates not only dilatation but a fusiform aneurysm of the ascending aorta. In the lateral position, the dilatation of the ascending aorta appears to manifest itself more conspicuously than in the anterior position, as is shown by the almost complete obliteration of the anterior transparent triangle (Figs. 5-*B* and 6-*B*). This is due, in my opinion, to the fact that the ascending aorta meets with very little resistance anteriorly because of the pulmonary tissue, which is easily compressible; but it is very likely that it meets with considerable resistance in its lateral displacement on account of the large blood vessels which are located on its sides, namely, the vena cava superior and pulmonary artery. The left border of the great blood vessel shadow is very little changed by dilatation of the ascending aorta. When the left border is found to project further to the left it is generally due to dilatation of the pulmonary artery, or left auricle, or both.

2. Elongation of the aorta is recognized in the anterior position by elevation of the

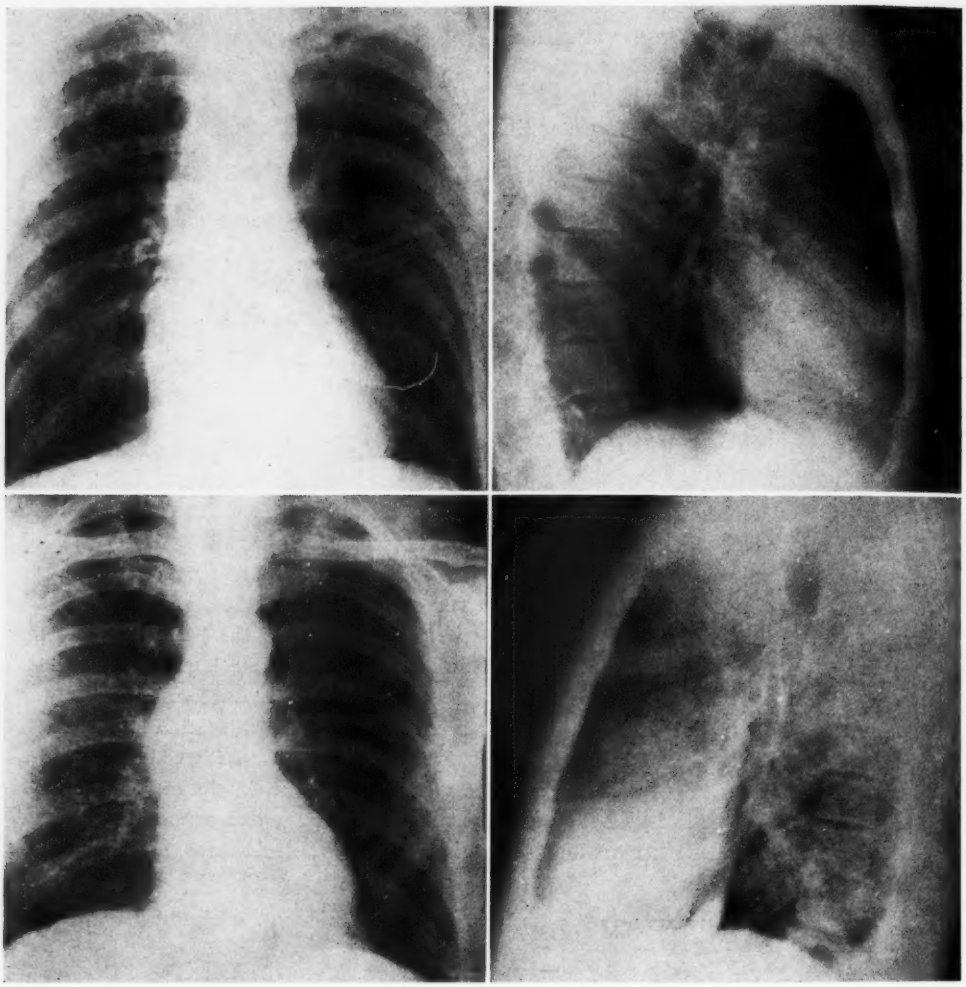

Fig. 5-*A (upper left).* The right border of the great blood vessel shadow extends beyond the sternal border. The left aortic semicircle is enlarged from above downward.

Fig. 5-*B (upper right).* The ascending aorta is dilated, obliterating the anterior transparent triangle.

Fig. 6-*A (lower left).* The right border of the great blood vessel shadow projects further to the right than the right border of the heart.

Fig. 6-*B (lower right).* The anterior transparent triangle is entirely obliterated, due to dilatation of the ascending aorta.

arch, by increased prominence of the aortic knob, and by displacement of the left border of the descending aorta to the left. In the lateral position, elongation of the aorta is recognized by the increased radius of the arch of the aorta and by the displacement of the descending aorta toward the back, thus overlapping the dorsal spine.

3. In speaking of dislocation of the aorta, we refer to local abnormal changes and not to a general dislocation, which is due to abnormal changes in the lungs or pleuræ. Projection of the descending aorta to the left is usually due to dislocation as a result of dilatation, or elongation, or both. In the lateral position, such an aorta will be found dislocated also to the back, thus overlapping the dorsal spine.

Fig. 7-*A (upper left)*. The aortic circle is enlarged. The descending aorta is displaced to the left.
Fig. 7-*B (upper right)*. Aneurysmal dilatation of the arch, affecting chiefly the concave surface.
Fig. 8-A *(lower left)*. Double aortic semicircle. The arch is dilated.
Fig. 8-*B (lower right)*. Saccular aneurysm displacing the trachea forward, evidently arising from the posterior portion of the arch.

4. In cases of dilatation or elongation, the arch is generally found to be elevated, thus encroaching upon the superior mediastinum. The region above the arch, which appears to be widened, is often mistaken for a substernal thyroid, but the condition is due only to the widening of the blood vessels which arise from the arch of the aorta.

5. Depression of the arch is usually due to one of two causes, aneurysms or tumors in the superior mediastinum. The differential diagnosis between the two is often very difficult to make. The tendency for an aneurysm to be located just above the arch corresponding to the region of the innominate artery and the tendency of a tumor to occupy the more anterior portion of the

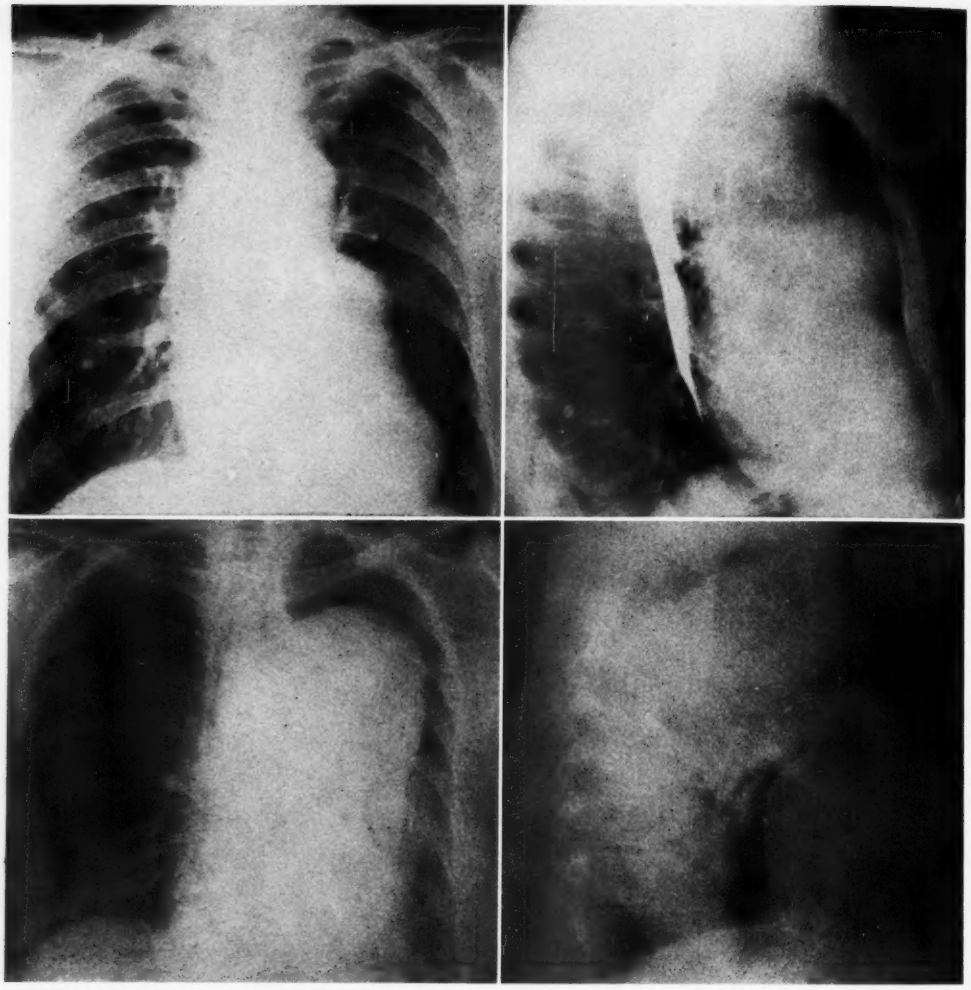

Fig. 9-*A (upper left)*. Dilatation of the ascending aorta and arch. Saccular aneurysm arising from the left side of the ascending aorta.
Fig. 9-*B (upper right)*. The aneurysm projects forward. The esophagus is displaced backward.
Fig. 10-*A (lower left)*. Marked dilatation of the arch and descending aorta.
Fig. 10-*B (lower right)*. Obliteration of the anterior transparent triangle and aortic loop. The descending aorta is overlapping the spine and ends in a blind pouch apparently due to a dissecting aneurysm.

superior mediastinum should be kept in mind. This finding has been frequently observed in our cases.

6. In cases of dilatation or elongation of the aorta, the arch describes a greater circle, thus increasing the radius of the circle. This finding is naturally best observed in the lateral position of the chest. One finds the ascending aorta close to the anterior chest wall, while the descending aorta is overlapping the spine, increasing the distance between the two parts of the aorta.

7. The prominence of the aortic knob is generally due to elongation or dilatation of the aorta. When the prominence is due to elongation without dilatation, the cord is not increased in the aortic semicircle. When the prominence of the knob is due to dilata-

tion, the cord of the aortic semicircle is increased.

8. Double semicircles are occasionally observed and are due to one of three causes. Dilatation or displacement of the upper end of the descending aorta to the left will show a double semicircle. In the lateral position, the cause of the double circle is promptly shown to be due to the descending aorta. Aneurysmal dilatation of the arch will produce the same finding, but, in the lateral position, the dilatation of the arch may readily be seen (Figs. 7-*A* and 7-*B*). If saccular aneurysms happen to overlap the arch, they may produce the same picture; but, in the lateral position, the presence of the saccular aneurysm behind the arch may be quickly discovered (Figs. 8-*A* and 8-*B*).

9. Increased opacity of the aorta is generally due to an increase in the fibrous tissue in the vessel wall (Figs. 2-*A* and 2-*B*), to the presence of calcareous deposits, and, chiefly, to the increased caliber of the vessel which enables it to contain a greater amount of blood.

10. Under normal conditions, the shape of the aorta is regular. The arch presents a true half-circle when it is viewed in the lateral position. The descending aorta is usually straight and is parallel with the spine. When the spine is kyphotic, the descending aorta follows the shape of the curvature of the spine. Under abnormal conditions, when the aorta is dilated or elongated, or both, the shape of the aortic arch may be square. The descending aorta may be found definitely angulated as a result of pressure from above.

11. The aortic walls may lose their parallelism as a result of a local dilatation in the vessel wall, resulting in an aneurysmal formation. The most frequent site of local dilatations is the ascending aorta or the arch.

12. The contour of the vessel wall may show a localized bulging, which is the forerunner of an aneurysm or it may be distorted as a result of adhesions or displacement. This is best recognized when the esophagus contains a contrast medium.

13. Calcareous plaques are most often seen in the region of the aortic knob. In the lateral position, they may be seen anywhere in the aorta.

14. Because of the intimate relationship between the aorta and its neighboring structures, a change in the shape or size of the aorta will produce a corresponding change in them. Thus, a displacement of the trachea or esophagus to the right will indicate a dilatation of the arch. Both the trachea and esophagus may be displaced forward or backward, depending upon the origin of the aneurysm. Aneurysms arising from the anterior portion of the arch will displace the trachea and esophagus backward. The reverse is the case when aneurysms arise from the posterior portion of the arch. Thus, the determination of the position of the esophagus and trachea may assist in determining the exact origin of an aneurysm. The displacement of the lower end of the esophagus to the left should lead one to suspect an aneurysm arising from the descending aorta just above the diaphragm.

15. Dilatation of the ascending aorta or of the arch of the aorta, or the presence of an aneurysm, invariably obliterates to a degree the anterior transparent area between the vessel and the sternum. In the determination of dilatation of the ascending aorta, obliteration has been found to be a more accurate guide than the study of the vessel in the anterior position, in which the condition of the clear area cannot be made out, although it is readily seen in the lateral position (Fig. 5-*B*). The presence of tumors in the anterior mediastinum will also obliterate the anterior clear area, but of this more will be said under another heading.

16. The aortic loop is often obliterated by an aneurysmal dilatation of the arch. The bronchus is frequently found displaced

downward as a result of an aneurysm of the arch which, at the same time, obliterates the loop.

17. Circumscribed dense shadows along the course of the aorta may be due to aneurysms or mediastinal tumors. The differential diagnosis between the two conditions is often very difficult to make. The presence of expansile pulsations generally indicates an aneurysm; however, their absence does not exclude an aneurysm. If there is doubt about the exact nature of the shadow, x-ray treatment may be tried. In the case of a mediastinal tumor, the shadow may entirely disappear, but it will not in the case of aneurysms. Saccular aneurysms arise more frequently from the region of the ascending aorta or arch than the descending. The point of origin may determine its direction. Thus, an aneurysm arising from the right wall of the ascending aorta is directed to the right and forward; an aneurysm arising from the left wall is directed to the left and forward (Figs. 9-*A* and 9-*B*). The same applies to the arch and descending aorta. It is evident, therefore, that the exact origin of an aneurysm can be determined by the use of true anterior and lateral views. Dissecting aneurysms are very difficult to recognize, and only one case in our series appears to be due to a dissecting aneurysm (Figs. 10-*A* and 10-*B*). In this case there is shown a marked general dilatation of the entire aorta, which ends in a blind pouch just above the diaphragm.

18. Displacement of the heart may be due to pleuropulmonary conditions, which do not interest us in this connection; only displacement as a result of aneurysms will be discussed. An aneurysm arising from the ascending aorta or arch has a tendency to displace the heart downward.

19. Diseases of the heart involving the aortic valves are frequently associated with dilatation of the aorta, which is especially true in cases of aortic regurgitation.

20. Alteration of aortic pulsations may be observed only with the fluoroscope. As a rule, dilatation of the aorta is accompanied by weak pulsations.

21. As a result of pressure against a bone by an aneurysm, atrophy, or even necrosis, may take place.

CONCLUSIONS

The importance of the study of the thoracic aorta in the true anterior and lateral positions has been fully emphasized. A knowledge of the relationship which exists between the aorta and the neighboring structures has been shown to be absolutely essential in order to enable one to recognize abnormal changes in the aorta. Twenty-one abnormal changes recognizable by x-rays, which are associated from time to time with diseases of the aorta, have been described.

DISCUSSION

DR. H. B. PODLASKY (Milwaukee, Wis.): I think Dr. Brown's endeavor to get away from the mathematics involved in measuring the heart and aorta is most commendable. After all, the medical man is interested not so much in diameters as he is in the relation of the structures that he is concerned with to surrounding organs. Whether we can all duplicate Dr. Brown's work remains to be seen, but to get away from mathematics and to consider anatomy in clinical terms is certainly a step in the right direction.

DR. SAMUEL BROWN (closing): I hope the lateral position of the chest will be used more and more by radiologists. I have learned many things about the heart and aorta in the lateral view which I failed to learn in the usual anterior view. Measurements of the heart and aorta do not mean a great deal to me because these organs are variable even under normal conditions. I prefer to draw my conclusions from changes in the relationship between the heart and aorta and the thoracic cage. When the heart is enlarged or the thoracic aorta is dilated, there is invariably a change in the relationship of the intrathoracic structures.

SYMPOSIUM ON PULMONARY ABSCESS, BRONCHIECTASIS, AND PULMONARY NEOPLASMS: CLINICAL, ROENTGENOLOGIC, BRONCHOSCOPIC, AND SURGICAL ASPECTS

PULMONARY ABSCESS, BRONCHIECTASIS, AND PULMONARY NEOPLASMS: CLINICAL ASPECTS[1]

By ELMER H. FUNK, M.D., PHILADELPHIA

SHORTLY after the introduction of the stethoscope and the recognition of the increasing importance of the physical examination in the diagnosis of thoracic diseases, a hundred years ago, William Stokes, the distinguished Irish clinician, wrote as follows:

"It has been objected to the advocates of the stethoscope that they discard the consideration of symptoms, and that throwing overboard all the knowledge we possessed previous to the introduction of auscultation, they pretend to ascertain the existence of all diseases of the chest by the sole observation of physical signs."

Stokes pointed out that such an attitude was wholly groundless and betrayed an ignorance of the subject. The implication to be found in Stokes' writings is that the new discovery of the stethoscope did not replace a consideration of the history and of the symptoms but, rather, emphasized and gave a new value to the older methods. Indeed, one might with equal propriety point out at the present time the importance of recognizing that neither bacteriology or roentgenology, nor yet bronchoscopy, can replace a careful study of the history, the symptoms, and the physical findings in a given case. Indeed, it is of first importance to recognize that in the modern diagnosis of diseases of the chest there are no short-cuts; that diagnosis is dependent upon a careful consideration of the history and symptoms, a painstaking physical examination (and not only of the chest), repeated and dependable laboratory studies, and skillful roentgenologic and bronchoscopic examinations. This requires the team work of internist, roentgenologist, bronchoscopist, and surgeon; and it is only by team work that the maximum of diagnostic accuracy and therapeutic success can be achieved in that group of diseases which are briefly discussed in this symposium—pulmonary abscess, bronchiectasis, and bronchial carcinoma.

PULMONARY SUPPURATION

Cough and the expectoration of mucopurulent sputum occur in a variety of nontuberculous bronchopulmonary lesions. The term, "pulmonary suppuration," though widely used, is indefinite and there is little excuse for its use except as a *tentative* designation for a group of diseases, the separation of which is essential in treatment. The group includes the pulmonary suppurative changes resulting from an aspirated foreign body, pulmonary abscess following acute respiratory tract infection and surgical operation (especially on the upper respiratory tract), abscess secondary to bronchopulmonary newgrowths, bronchiectasis, and a miscellaneous group, *e.g.*, the pulmonary suppurative lesions which result from the extension of suppuration of the pleura and mediastinum. Bronchial obstruction from any cause tends to favor the occurrence of abscess and bronchiectasis, both of which lesions, in varying predominance, may be present in the same patient.

The three diagnostic problems which pa-

[1]Read before the Radiological Society of North America, at the Seventeenth Annual Meeting, at St. Louis, Nov. 30–Dec. 4, 1931.

Dr. Funk died before proof was submitted. His colleagues made such revision as they believed he would have desired.

tients with evidences of pulmonary suppuration present are: (1) What is the lesion —is it a diffuse purulent pneumonia—is it an abscess—is it a bronchiectasis? (2) Where is it located? (3) What is the cause? The answers may be difficult to obtain but effective treatment depends in a large measure upon them.

PULMONARY ABSCESS

Although the methods and sources of infection in pulmonary abscess vary, it appears that the vast majority of abscesses occur after tonsillectomy. Excluding abscess due to aspiration of a demonstrable foreign body, and abscess secondary to newgrowth, both of which have certain destructive pathologic and clinical features, an analysis[2] of a series of 172 cases showed that in approximately 70 per cent the pulmonary abscess followed a surgical operation, tonsillectomy and oral operations accounting for eight out of every nine in the post-operative group. In 25 per cent of the entire series, the pulmonary abscess followed acute respiratory tract infections, including pneumonia and bronchopneumonia, and in the remaining 5 per cent of the series, injury, drowning accidents, and undetermined causes played a part.

Pulmonary abscess may occur at any age —one-half of our patients were between 20 and 40 years of age. This is in contrast to the predominance in the earlier years of life of abscess due to aspirated foreign body, and, in later years, of abscess associated with newgrowth.

Pulmonary abscess may be single or multiple and occur in any part of the lung. In our series the abscesses were localized in one lobe in 79 per cent, in two lobes in 19 per cent, and in three lobes in less than 2 per cent of the cases. Smith[3] recently and others in the past have stated that the right side and the lower lobes are more frequently involved. In our experience, involvement of the upper lobe is more common. Accurate information regarding the location of an abscess or abscesses is important when surgical intervention is considered.

TABLE I.—DISTRIBUTION OF PULMONARY ABSCESSES

Monolobar Lesions (134 Cases)	
Right upper lobe	49
Right middle lobe	10
Right lower lobe	22
Left upper lobe	30
Left lower lobe	23
Multilobar Lesions (35 Cases)	
Unilateral (33 Cases)	
Right middle and lower lobes	14
Right upper and lower lobes	4
Right upper and middle lobes	4
Left upper and lower lobes	11
Bilateral (2 Cases)	
Right middle and lower lobes and left upper lobe	1
Right upper and middle lobes and left upper lobe	1

The infection in pulmonary abscess is usually *polymicrobic*. Bucher[4] has recently reported the bacteriologic studies of pus obtained directly from the infected area by means of bronchoscopy. Fusospirochetal infection evidently plays an important part in the etiology of pulmonary abscess, and is an unfavorable factor in prognosis. Good results with arsphenamine therapy have been reported, but my own experience has been discouraging. Smith[5] recently reported three cases of fusospirochetal disease of the lungs treated satisfactorily with sulpharsphenamine begun on the third, fourth, and fifth days, respectively, of the illness. These results indicate that the prompt use of arsphenamine preparations is important.

Diagnosis.—This requires a complete study, including bronchoscopy. The occurrence of cough and fever after operation, especially about the upper respiratory tract, should focus attention on the possibility of pulmonary abscess. The sudden appearance of purulent expectoration or the occurrence of a severe paroxysm of cough during which considerable pus is expecto-

[2]Flick, J. B., Clerf, L. H., Farrell, J. T., and Funk, E. H.: Pulmonary Abscess: An Analysis of 172 Cases. Arch. of Surg., 1929, XIX, Part II, p. 1292.

[3]Proc. Nat'l Tuberc. Assn., 1931.

[4]Am. Jour. Med. Sci., 1930, CLXXIX, 406.

[5]Jour. Am. Med. Assn., 1930, XCIV, 23.

rated, is highly significant, although this may occur in perforating empyema and perforating subdiaphragmatic abscess. The presence of elastic fibers in the sputum in the absence of tubercle bacilli is evidence of a non-tuberculous destructive lesion. The physical signs are not distinctive. The small deep-seated abscess may give rise to marked symptoms and indefinite signs: in the larger and more superficial abscesses the signs are usually those of consolidation, which may occur in any part of the chest. A pleuritic friction sound is common, though frequently overlooked. Distinct cavity signs are so infrequent in pulmonary abscess that their absence should have no weight in diagnosis. The roentgen and bronchoscopic examinations are invaluable in the complete diagnostic study.

CONDITIONS TO BE DIFFERENTIATED FROM PULMONARY ABSCESS

1. *Tuberculosis.*—Pulmonary abscess, especially of the upper lobes, may easily be mistaken for pulmonary tuberculosis unless the history, the character of the sputum, including the presence of tubercle bacilli, and the roentgenologic observations are carefully considered. Patients with pulmonary abscess incompletely studied are not infrequently referred to tuberculosis sanatoriums.

2. *Bronchiectasis.*—In recent cases of pulmonary abscess, the differentiation from bronchiectasis is usually not difficult. In the chronic cases the complete examination is usually conclusive. In some of these, however, the lesions of abscess and bronchiectasis present so much in common and so frequently co-exist that the differentiation may be very difficult without bronchoscopic pneumonography.

3. *Pulmonary Suppuration Due to Aspirated Foreign Body.*—This is more common during the early years of life, but may occur at any age. The history may be inconclusive and the latent interval between aspiration and the development of pulmonary symptoms may be misleading. The symptoms and signs may resemble those of non-foreign-body abscess; however, in cases of foreign bodies the asthmatoid wheeze, the tendency of the signs to change with the shifting of the foreign body, and the occurrence of signs of bronchial obstruction are commonly found. The roentgenologic and bronchoscopic examinations are conclusive.

4. *Interlobar Empyema.*—The physical signs are most marked in the region of the interlobar septum; there may be some displacement of the heart, and the sputum, if purulent, rarely contains elastic fibers. The roentgenologic observations are important.

5. *Neoplasm.*—This will be discussed later.

6. *Syphilis and the Mycotic Infections.*—These are rare. The history, concomitant evidence of syphilis or of the mycoses in other parts of the body, the Wassermann test, and the studies of the sputum are important.

7. *Pulmonary Gangrene.*—The distinction is not difficult in the typical case with marked fetor of the breath and sputum and profound systemic disturbance. In other instances the lesions of abscess and gangrene so closely resemble each other that differentiation is not possible. The finding of spirochetes and fusiform bacilli does not serve to differentiate the two conditions.

Treatment.—This may be considered under two headings: *(a)* conservative, including bronchoscopy, and (not *or*) *(b)* surgical. I should like to emphasize that *(a)* and *(b)* have definite indications and are not infrequently combined. The medical care includes rest and hygienic dietetic measures to improve the general condition of the patient. Medical treatment alone is indicated in the early acute phase of pyogenic infections before abscess formation has occurred. Postural drainage is important in supplementing bronchoscopic drainage. Generally it is desirable to treat pulmonary abscess conservatively, including bronchoscopy, unless sur-

gical intervention is definitely indicated at the time the patient comes under observation. The possible advantage of surgical measures is considered in every patient, but they may be spared the external operation by careful bronchoscopic treatment. Conservative measures may prepare the patient for surgical intervention, but, on the other hand, the disease should not be allowed to go on until fibrosis and bronchiectasis occur and render the ultimate surgical intervention difficult and unsatisfactory.

Artificial pneumothorax has been recommended. Its value is questionable, its use is dangerous, and, in my opinion, it is definitely contra-indicated.

The use of arsphenamine in fusospirochetal infections has been mentioned.

Of considerable value are small transfusions of whole blood, especially in patients with marked secondary anemia; they are also useful in the preparation for operation and in the after-care of those treated surgically.

BRONCHIECTASIS

Bronchiectasis, especially in the milder forms, is common, and from etiology to treatment the various problems which arise are often a cause of difficulty. Dilatations are prone to occur whenever the integrity of the bronchial wall is impaired, as during acute and chronic inflammations; and when, in addition, there is an increase in the intrabronchial pressure, as occurs in bronchial obstruction either arising from within, as in foreign bodies or neoplasms, or from without, as in aneurysm, enlarged lymph nodes, tumor, etc. Bronchiectasis also results from extra-bronchial traction in pulmonary fibrosis, especially when the fibrosis is associated with pleural adhesions. An acute bronchiectasis occurs at times in influenza, and it is possible that a mild bronchiectasis so induced may eventuate in a progressively more marked type with the lapse of time. Bronchiectasis may follow even mild attacks of whooping cough and measles. There is a group of cases occurring in children and young adults, but not limited to these age periods, in which the bronchiectasis occurs insidiously during the course of a simple chronic bronchitis secondary to a latent focal infection in the upper respiratory tract, and especially of the nasal sinuses. I shall refer to this group in discussing treatment. The infection, as in abscess, is usually polymicrobic. The bronchoscopically aspirated secretions not infrequently contain spirochetes in association with other organisms.

The classical *symptoms and signs* of marked bronchiectas are well known: the atypical picture is often confusing. There is a group of patients with involvement of the upper lobe *without* paroxysmal cough and fetid expectoration. The upper lobe location permits freer drainage and the secretions do not tend to stagnation as in the lower lobe involvement. Most of these are of the localized traction type and occur in association with the fibrosis of healing or obsolete tuberculosis.

Since the introduction of bronchoscopy and pneumonography there has been observed a *dry hemoptysic* type of bronchiectasis in which the principal symptoms are a chronic cough, with no or scant expectoration, with recurrent attacks of blood-spitting, and the physical signs of chronic bronchitis, with moderate pulmonary fibrosis. Clubbing of the fingers is usually insignificant and general symptoms are absent. Bronchoscopic pneumonography has demonstrated the frequently unsuspected bronchial dilatations which usually are located in the lower lobes. This type of bronchiectasis may be present for years, and considered clinically as chronic bronchitis. Not infrequently it is discovered after an acute respiratory infection which gives rise to a profuse productive cough that is slow in clearing and easily recurs, and, upon investigation by bronchoscopy, is found to be due

to bronchiectasis. One can easily understand how the bronchiectasis in such instances may be assumed to be of recent origin when, in reality, it is of long standing. Localized bronchiectasis is practically always due to traction fibrosis or bronchial obstruction. From the clinical viewpoints of etiology, diagnosis, and treatment, it is convenient to classify bronchiectasis in two main types: (1) obstructive and (2) non-obstructive. The first includes those cases in which the bronchiectasis results from, or is associated with, bronchial obstruction, *e.g.*, foreign body, newgrowth, pressure by tumor or aneurysm, cicatricial stenosis, inspissated secretions, exuberant granulation tissue, etc.

Bronchoscopy, except in aneurysm, should be used whenever bronchiectasis is suspected, in order to determine the presence and character of the obstruction, and the possibility of removing it. In non-obstructive bronchiectasis, bronchoscopy aids principally by relieving the overtaxed mechanisms of cough and ciliary action by which secretions are naturally removed. Obviously this procedure cannot influence permanently dilated bronchi or correct certain extra-bronchial factors such as the traction on the bronchial wall, which occurs in bronchiectasis associated with pulmonary fibrosis. Bronchoscopy can, however, relieve the stagnation of secretions—an important factor in aggravating the bronchiectasis.

Collapse therapy, including artificial pneumothorax, phrenic paralysis, and thoracoplasty, is to be considered only in the non-obstructive types of bronchiectasis. Obviously these procedures are useful only in unilateral or predominantly unilateral cases. The simplest is artificial pneumothorax, and, if this is possible by reason of a free pleura, it is worthy of a trial, especially in children and young adults in whom not infrequently a temporary pulmonary collapse causes improvement and an apparent arrest of the disease. In adults, pleural adhesions and pulmonary fibrosis commonly interfere with satisfactory collapse from artificial pneumothorax. Compression pneumothorax, or the introduction of air under a positive pressure, is a dangerous procedure. I have seen several patients in whom compression pneumothorax was attempted, pleural adhesions were torn, and pyopneumothorax resulted. If the bronchiectasis is basal, phrenic exeresis should be considered. This is a simple procedure in the hands of the surgeon and if it does not benefit the patient, it is my experience that it does no harm. It may be used in conjunction with pneumothorax, especially when diaphragmatic adhesions apparently interfere with adequate collapse. If these procedures fail, or if the unilateral disease is marked, one of the major surgical procedures which my colleague Dr. Flick will discuss in this symposium should be considered. It is in the selection of the type of operation that special experience and skill in thoracic surgery are required.

When advanced bilateral bronchiectasis is present, none of the collapse methods is suitable, unless the one side has advanced disease and the other relatively slight involvement. Palliative treatment utilizing bronchoscopic and postural drainage combined with hygienic-dietetic care must be relied upon to make patients with hopelessly advanced bronchiectasis comfortable. The medical treatment, as outlined in the early part of this paper, is useful. Neoarsphenamine for spirochetal infections, and vaccines, especially autogenous vaccines made from bronchoscopically removed secretions, are of value.

In recent years, the recognition of the etiologic relationship of chronic focal infections in the upper respiratory tract to lower respiratory tract diseases suggests not only an important method of preventing bronchiectasis in some patients, but of lessening or ameliorating the symptoms once they have occurred. The clearing of focal infections, particularly of paranasal sinusitis, is most

helpful, especially in the early stages of bronchiectasis.

PRIMARY BRONCHIAL CARCINOMA

The increasing clinical interest in the diagnosis of primary carcinoma of the lung has been stimulated by the recognition that origin occurs in the larger bronchi in the vast majority of cases, and, therefore, bronchoscopic examination, with removal of a section of tissue for histologic study, is of great value in diagnosis. The predominance among men, the incidence after the age of 35, and especially in the decade between 35 and 45, are factors of significance in diagnosis.

The clinical features, to which the time allotted will permit only a brief reference, are variable: the early symptoms are those of bronchial irritation, and the early signs those of bronchial obstruction. The factors which vary the clinical picture are: (1) the location of the neoplasm and the rapidity of its growth; (2) the degree of bronchial obstruction produced; (3) the presence of secondary infection and suppuration; (4) the pressure on adjacent structures; (5) the occurrence of pleural involvement, which is not infrequently associated with effusion, and (6) the influence of local and general metastases. These factors in varying combinations produce many dissimilar clinical pictures, which may closely resemble either the common or the rare diseases of the chest. In a recent paper I[6] analyzed the local and general symptoms in a group of 61 patients. I wish simply to point out that the onset is not infrequently like an *acute respiratory tract infection;* pain in the chest of varying severity is common, and general symptoms such as weakness, loss of weight, and pallor are usually late manifestations. The wheezing of bronchial obstruction has not infrequently been mistaken for *asthma.*

Diagnosis: Latent Types.—Primary bronchial carcinoma may be unsuspected when the metastases in distant organs and tissues obscure the clinical picture. An interesting report which emphasizes this point is that by Fried and Buckley,[7] who found central nervous system metastases in 15 of 37 patients with bronchiogenic cancer. In 11 of the 15 patients a diagnosis of primary tumor of the brain was made and the bronchiogenic tumor was overlooked. An intracranial operation was performed in 11 patients and a metastatic tumor was removed in 10 instances. Fried and Buckley state that when a person of middle age has an abrupt onset of symptoms and signs of a rapidly developing intracranial lesion, a metastatic cerebral lesion should be thought of and that the lungs are the most common site of the primary lesion. A metastasis to the brain may be mistaken not only for a rapidly growing glioma but also for a vascular lesion or an encephalitis.

Metastatic Bronchopulmonary Neoplasm.—The opposite of the preceding is the patient in whom the symptoms of a primary lesion elsewhere in the body are obscured by the predominance of thoracic symptoms due to metastasis to the lung. Such intrathoracic metastases are usually multiple and easily recognizable roentgenologically. Rarely the localization simulates clinically and roentgenologically a primary endobronchial growth. Bronchoscopic and histologic diagnoses may fail, but such an occurrence is fortunately extremely rare, especially when complete diagnostic studies are made.

An essential in the diagnosis of bronchiogenic cancer is to recall that it is not rare and that it may simulate any other bronchopulmonary disease. Certain conditions especially cause confusion.

Tuberculosis.—The chronic cough, expectoration, hemoptysis, fever, and wasting are more frequently mistaken for tubercu-

[6] Funk, E. H.: Clinical Manifestations of Primary Bronchial Carcinoma. Jour. Am. Med. Assn., 1930, XCV, 1879.

[7] Fried, B. M., and Buckley, R. C.: Primary Carcinoma of Lungs: IV.—Intracranial Metastases. Arch. Path., February, 1930, IX, 483.

losis, especially when the bronchiogenic cancer invades the upper lobe: basal growths, with apexes clear, cause less difficulty. The sputum studies are important, and it is a good rule to question the diagnosis of tuberculosis when, in the presence of a persisting gross lesion, the sputum contains no tubercle bacilli.

Bronchial Obstruction.—The recognition of the presence of bronchial obstruction and the associated lesions of atelectasis, emphysema, bronchiectasis, and abscess are secondary in importance to the determination of the cause of the obstruction. Foreign bodies and aortic aneurysm may be recognized by the history, physical signs, and roentgen observations. On the other hand, neoplastic obstruction, while frequently suspected in adults of the cancer age with pulmonary lesions of obscure etiology, may often fail to be recognized unless bronchoscopic studies are made. Benign newgrowths and obstruction due to inflammatory changes and cicatricial stenosis can be differentiated only by bronchoscopy. Aortic aneurysm should be excluded before bronchoscopy is done. Carcinoma of the esophagus, as a result of the overflow of its contents and pressure on or penetration into the air passages, may give rise to distinct respiratory symptoms. In primary bronchial cancer the reverse process may produce esophageal symptoms. A careful study of the order of the appearance of symptoms and of the swallowing function and the roentgen and direct endoscopic examinations should establish the diagnosis. Tracheal cancer may give rise to symptoms not unlike those in bronchial involvement, and only by bronchoscopy can differentiation be made.

Pulmonary Abscess.—The differentiation of non-carcinomatous pulmonary abscess may present unusual difficulties. Generally speaking, a pulmonary abscess of obscure etiology occurring in a man past 30 or 35 should be suspected of a malignant origin. Bronchoscopy will usually settle the diagnosis. That errors may occur in spite of the most complete study is exemplified by the following case report.

A man, aged 51, had been ill for one year with cough, increasing expectoration, dyspnea, huskiness of the voice, and loss of weight. The physical and roentgen observations indicated an extensive lesion in the lower portion of the right upper lobe. The fingers were clubbed. The roentgenogram distinctly showed a large abscess cavity. No tubercle bacilli were found in the sputum. A bronchoscopic examination by Dr. Clerf revealed stenosis of the right bronchus, probably neoplastic, and a histologic study by Dr. B. L. Crawford revealed carcinoma. Autopsy revealed a primary carcinoma of the head of the pancreas, with metastases to peribronchial nodes and to various other organs. The pulmonary abscess was secondary to a malignant bronchial obstruction, which, in turn, was secondary to the primary abdominal neoplasm. However, carcinomatous pulmonary abscess is associated in the vast majority of instances with primary rather than secondary neoplasms.

Syphilis.—Pulmonary syphilis is rare, but it may simulate bronchopulmonary newgrowth. The history, atypical pulmonary signs, concomitant evidence of syphilis elsewhere, the positive Wassermann reaction, and the therapeutic test are criteria useful in the diagnosis of pulmonary syphilis, which is usually made by exclusion. The two conditions may co-exist, *i.e.*, bronchial cancer and latent syphilis. Curiously, in the series of 61 patients, the routine Wassermann test was positive in only two instances. Bronchoscopy will usually settle the differentiation between the two lesions.

Pneumoconiosis.—Long exposure to inorganic dust may give rise to localized pulmonary changes which, on roentgen examination, may suggest an associated neoplasm.

Pleurisy.—The pleura is almost always involved at some time during the course of bronchiogenic cancer, and at autopsy meta-

static pleural lesions are frequently found. Reference has been made to the frequency of pain in the chest, especially early in the disease. An exudative pleuritis, simple hemorrhagic or purulent, may mask clinically the underlying bronchiogenic neoplasm. Effusion was present in 16 of the 61 patients (26.2 per cent); serous or serofibrinous in 3, purulent in 3, and hemorrhagic in 10. While the dullness and the distant breath sounds of atelectasis may, if the displacement phenomena are not carefully studied, mislead to a dry tap, it is important to remember that not infrequently effusion associated with bronchiogenic carcinoma does not cause distinct displacement of the heart and mediastinum to the opposite side. In other words, the presence of an effusion is often difficult to determine apart from a diagnostic pleural puncture. The laboratory examination of the fluid has not been helpful in diagnosis. The hemorrhagic character is suggestive. The careful clinical study, suggestive features such as an undetermined cause, persisting pain, dyspnea out of proportion to the pleural involvement, symptoms of associated and persistent bronchial irritation, atypical roentgen observations, and a negative tuberculin test all suggest the need for complete diagnostic study, which, when bronchoscopy is included, may reveal the obscure bronchiogenic cancer.

Not only the common but the rare thoracic diseases, for example, the various mycoses, may at times require differentiation from bronchiogenic carcinoma.

PULMONARY ABSCESS, BRONCHIECTASIS, AND PULMONARY NEOPLASMS: ROENTGENOLOGIC ASPECT[1]

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THE roentgenologist must assume definite responsibilities in the diagnosis and treatment of pulmonary abscess, bronchiectasis, and pulmonary neoplasm. His team associates, the internist, the bronchoscopist, and the surgeon, may expect from him assistance in diagnosis, help in localization, graphic recording of change, and, in certain types of newgrowth, aid in treatment.

ABSCESS

The roentgen appearance of pulmonary abscess is determined by the stage of the disease, the site of involvement, the presence of complications, and the technic of examination.

At the onset it presents an almost homogeneous density, due to localized pneumonitis. The shape of the shadow depends upon the site. Near the hilum it is usually small and may resemble a collection of enlarged lymph nodes; in the center of a lobe, unlimited by an interlobar fissure or visceral pleura, it is of irregularly rounded shape, without distinct margin, dense at the center and fading off into normal tissue. Limitation by the interlobar fissure produces a triangular outline.

Abscesses of this shape occur in the right upper lung field where the lower border of the inflammatory area is limited by the interlobar fissures. The triangular outline is seen on anteroposterior and lateral roentgenograms. This stage of pneumonitis may last for a long time or be followed rapidly by the development of a characteristic cavity.

Necrosis of the center of the area and evacuation through a bronchus lead to the development of a cavity, appearing on the

[1]Read before the Radiological Society of North America, at the Seventeenth Annual Meeting, at St. Louis, Nov. 30-Dec. 4, 1931.

roentgenogram as a central area of increased translucence. The cavity of acute pulmonary abscess does not have a well defined wall: at the hilum it is smaller than at a distance. The hilar abscess usually does not cover an area more than 3 cm. in diameter on anteroposterior roentgenograms, while, centrally located in a lobe, it may occupy an area 8 to 10 cm. in width. Fluid is usually present in the cavity and its level can be altered by changing the position of the patient.

Etiologic factors and complications alter the characteristic appearance. When due to the aspiration of an opaque foreign body one may detect the object. Pleural changes alter the appearance of abscess more than other conditions: edema of the pleura or fluid in the pleural cavity may completely obscure it, while an interlobar collection of exudate may hide the lesion—frequently, it is difficult to differentiate the two.

In some instances independent suppurative foci develop in the opposite lung or at a point in the same lung distant from the primary abscess. These foci appear in varying numbers as small pea-sized areas. They may coalesce to form a new area of massive pneumonitis and go on to central necrosis and the formation of a second abscess.

Displacement phenomena are not prominent in abscess, and are seen only in cases with pleural complications. They occur principally as elevations of the diaphragm. The heart and mediastinal structures are affected rarely.

With healing, the area of density surrounding the cavity and the cavity itself become smaller, fluid in the cavity lessens, and there is a gradual diminution in both density and extent of the lesion. Small secondary foci disappear by absorption without the intermediary stage of cavity formation. Sometimes linear shadows due to fibrous tissue formation remain at the site of the abscess, and in the upper lobes may be mistaken for tuberculous fibrosis unless one is acquainted with the history of the patient.

Rib resection for drainage of pulmonary abscess alters the roentgen appearance of the chest. Absence of ribs and the resultant deformity are striking when resection is done in the mid-axillary line. When done anteriorly or posteriorly, the deformity is not so marked, and even on the lateral views may be obscured by the shadows of the sound side. Packing the wound with iodoform gauze at the first stage to obliterate the pleural cavity may increase the area of density so as to simulate spread of the abscess. Incision into the abscess, with evacuation of necrotic contents, lessens the size of the area of density unless indurated lung surrounds the central cavity; then evacuation produces no noticeable change on roentgenograms made shortly afterwards. Usually, however, the area of involvement increases in density and extent because of trauma to the soft tissues and pleura during operation, a post-operative increase not to be looked upon as extension of the disease. Changes in the position of the thoracic organs after operation are seen only in lesions associated with pleural complications (Farrell, 1). The diaphragm on the affected side is sometimes elevated; but the position of the other organs is rarely disturbed.

For accurate localization of pulmonary abscess anteroposterior and lateral roentgenograms are essential. In uncomplicated cases the exact relation to the chest wall can always be determined. Sometimes, for an accurate roentgen lobar localization, it may be necessary to instil iodized oil through the bronchoscope. Anteroposterior and lateral views indicate the lobar site, either by direct entrance of the opaque medium into the abscess cavity or by outlining the encompassing normal tissue in cases in which the oil is excluded from the involved area because of plugged bronchi. Fluoroscopic instillation of the iodized oil is oftentimes of great

value in localization. Massive changes in the pleura may make it impossible to determine roentgenographically the exact location of the lesion.

Acute pulmonary abscess has certain roentgenographic characteristics which serve to differentiate it from tuberculosis. Usually, the area of involvement is localized and unaccompanied by evidence of disease elsewhere in the lungs. In most instances there is but a single cavity, though sometimes this is multilocular; rarely are there multiple cavities. The cavities practically never have well defined walls, are only rarely found in the apex, and usually show fluid levels because of their liquid content. Tuberculous cavitation is usually apical and multiple; and, except during the stage of active caseation, cavity walls are well defined and contain no fluid. Tuberculosis with cavity formation is always accompanied by other tuberculous changes, notably tubercle formation in other portions of the lung.

Abscess following infection and necrosis of a pulmonary newgrowth often presents no characteristic appearance, and, unless there are metastatic nodules elsewhere in the lung, its neoplastic origin may not be apparent from the roentgen examination alone.

Interlobar empyema is sometimes difficult to differentiate from abscess, particularly after rupture into a bronchus produces a hydropneumothorax resembling an abscess with cavity. Lateral roentgenograms are important in the diagnosis of both encapsulated interlobar empyema and pyopneumothorax. An area of density without cavity in the middle or lower lung fields, having a sharply limited margin corresponding to the projection of an interlobar fissure, should lead one to suspect an interlobar empyema. In encapsulated pyopneumothorax the bubble of air above the fluid level occupies the highest portion of the area of involvement, while the cavity in abscess is usually surrounded by dense lung so that the bubble and fluid level lie more centrally in the diseased area. Multiple fluid levels in a multilocular pyopneumothorax sometimes simulate multiple pulmonary abscesses.

BRONCHIECTASIS

According to origin, bronchiectasis may be divided into two types: first, bronchiectasis due to long continued bronchial occlusion, and second, bronchiectasis due to disease of the bronchial wall. When secondary to occlusion it is usually unilateral, and frequently so massive as to involve a whole lobe. Bronchiectasis due to changes in the bronchial wall is often bilateral, usually basal, and is less massive than the first type. Softening of the bronchial wall is frequently but part of general disease of the mucous membrane of the entire respiratory tract, seen in association with infection of the accessory sinuses.

The process of development of the obstructive type is demonstrated by cases of foreign body in the bronchus in which there is complete occlusion. Absorption of air distal to the foreign body leads to atelectasis (Manges, 2). Infection of retained secretions in the collapsed portion of the lung ends in the cavity formation of bronchiectasis. Occlusion of the bronchus by an endobronchial neoplasm, by pressure from mediastinal masses, or by tuberculous ulceration may lead to similar changes.

Large cavities may sometimes be recognized on direct examination, but often they are hidden by massive areas of indurated lung. Exact localization and delineation of cavities can be done only by bronchoscopic instillation of an opaque medium, such as iodized poppy seed oil.

Collapsed lung surrounding bronchiectatic cavities frequently becomes so dense that the pulmonary tissue cannot be differentiated from the heart or diaphragm.

Massive unilateral bronchiectasis is always associated with displacement of the mediastinal structures toward the affected

side, due in part to atelectasis, and in part to scar tissue formation in the diseased lung. Cardiac displacement is more pronounced when occlusion occurs on the right side.

In bronchiectasis due to softening of the bronchial wall, as occurs in association with disease of the accessory sinuses, the density of the involved area is not so great as in cases in which the lesion follows occlusion, a type which is frequently bilateral. At onset, filamentous shadows extending from the root areas downward and laterally into the lower lung fields are indicative of the disease. Progression leads to increase in the width and extent of these linear markings. When the condition is long continued, a large part of a lobe may become dense.

Cavities in this type of bronchiectasis are never as large as they are when the disease is due to occlusion. Occasionally, they may be made out by direct examination, though usually a bronchoscopic pneumonography is necessary for the determination of their presence. When the extent of the lesion is not great it may be necessary to instil the opaque oil under the fluoroscope so that minimal changes may be noted as it enters. Dilatations are of two principal varieties, the cylindric and the saccular. The cylindric is due to generalized dilatation of the bronchi, the saccular to localized areas of dilatation producing small cavities studded along the bronchi. Unless the dilatation remains unilateral and progresses so that a large portion of a lobe is involved, displacement phenomena are not pronounced.

Bronchoscopic drainage of bronchiectatic areas lessens the density of the shadows in the affected portion of the lung, the degree depending upon the amount of secretion removed and the extent of the induration of the tissues surrounding the cavities. This latter factor is, in turn, determined by the duration and severity of the primary bronchial infection. When bronchiectasis is associated with disease of the accessory sinuses treatment of the sinus infection often brings about a decrease in the pulmonary markings.

Severance of the phrenic nerve in the treatment of bronchiectasis elevates the diaphragm on the affected side, and one can detect paradoxical movement of the diaphragm by the fluoroscope. With inspiration, it descends on the normal side and on the diseased side rises, while, with expiration, it rises on the normal and descends on the diseased, a paradoxical movement due to normal variations in intra-abdominal pressure occurring during the respiratory cycle. Increase in pressure during inspiration forces the non-resistant diaphragm on the side of the phrenic resection upward; decrease with expiration allows it to descend.

Rib resection and thoracoplasty produce changes on the roentgenogram commensurable with the number and portion of the ribs resected and the extent of the disease. Resection of the lower ribs collapses the lower lobe and increases the density of the shadows of this portion of the chest: resection of the greater portions of all the ribs leads to further collapse and to striking deformity of the thorax. Sinking in of the chest wall obliterates cavities and produces a homogeneous increase in the shadows of the affected side.

Increase in lower-lobe markings in early bronchiectasis must be differentiated from that associated with cardiac failure, from the increase in markings seen in some cases of asthma, and from a residual increase sometimes persisting after lobar pneumonia. When the increased markings are due to passive congestion, enlargement of the heart shadow is usually present and the markings are diffuse and less linear in character. Pleural effusion is frequently associated with passive congestion, while it is rare in uncomplicated bronchiectasis. Increased lower lobe markings seen in asthma can be differentiated from those of bronchiectasis only by the bronchoscopic instillation of iodized oil. In asthma, the bronchi are of

normal width because the thickening of the tissues is extra-bronchial and unassociated with dilatation of the air passages. Increased markings remaining after pneumonia usually lessen gradually and in time disappear, while in bronchiectasis the markings persist.

PULMONARY NEOPLASM

The roentgen appearance of pulmonary neoplasms has been described in recent years by many, among them the author (3). Roentgenologic diagnosis depends upon: first, the type of newgrowth; secondly, its location, and thirdly, the changes which follow its presence. Endobronchial neoplasm leads first to narrowing of the bronchus. At onset it is essentially an intrinsic foreign body and changes described by Manges (4) as secondary to partial bronchial occlusion accompany it. These signs are: obstructive emphysema of the affected lobe or lung, displacement of the heart away from the side of involvement, diminished excursion or fixation of the diaphragm in the inspiratory position during expiration, and failure of the affected side of the chest to contract with expiration.

Continued growth of the tumor brings about complete bronchial occlusion and collapse of the lung distal to the neoplasm. The involved lobe or lung becomes an airless mass, the density of which approaches that of the heart and diaphragm, and displacement of the mediastinal organs toward the affected side follows, with diminution in the size of the involved half of the chest.

Suppurative processes in this collapsed lung lead to abscess formation. Atelectasis in an adult or abscess formation associated with atelectasis should cause one to suspect endobronchial neoplasm.

The phenomena of obstruction vary from time to time. Evacuation of the neoplastic tissue following necrosis lessens the degree of collapse and the displacements characteristic of atelectasis are diminished. Similar changes take place in the signs when the tumor is removed bronchoscopically.

Since extra-bronchial newgrowths cast shadows, recognition of the tumor mass and the changes which take place in it is the basis of the roentgen diagnosis. The character of the mass depends upon size and location: at the hilum a small growth may be mistaken for an enlarged lymph node or it may be completely hidden in the normal shadow of the root area, while in the center of the lung its shadow can be recognized.

Extra-bronchial newgrowth in the upper portion of the chest close to the median line resembles aneurysm of the aorta, aneurysm of the innominate when on the right side, and in some instances substernal enlargement of the thyroid or mediastinal tumor. Expansile pulsation differentiates aneurysm and tumor. When the shadow of the newgrowth falls close to the mediastinal margin of the lung it may be impossible to differentiate roentgenographically between substernal thyroid, mediastinal newgrowth, and extra-bronchial pulmonary neoplasm.

Pressure by an extra-bronchial newgrowth on a large bronchus partially occluding the bronchus produces the signs of obstructive emphysema, but when occlusion is complete it leads to atelectasis. In some instances the shadow of the newgrowth may be lost in the shadow of the collapsed lung. Suppurative processes developing in extra-bronchial newgrowth end in abscess formation.

Metastatic lesions may develop in other portions of the lung field at a distance from the primary endobronchial or extra-bronchial neoplasm. Metastasis indicates the malignant origin of the process, but it is often impossible to determine whether the primary lesion is in the pulmonary structures or in some other part of the body. Pleural complications, edema of the pleura.

effusion, or empyema may completely hide a newgrowth.

SUMMARY

1. The other members of a diagnostic and therapeutic team studying diseases of the chest may expect from the roentgenologist, assistance in diagnosis, aid in localization, a graphic record of the progress of the disease, and, in some varieties of neoplasms, aid in therapy.

2. The roentgenographic appearance of any pulmonary abscess is determined by the stage of the disease, the site of involvement, the existence of complications, and the technic of examination.

3. The roentgenographic appearance of bronchiectasis is determined by its origin, whether due to occlusion, or occurring as a part of a generalized infective process of the mucous membrane of the respiratory tract. The exact architectural changes can be accurately delineated only by instillation through the bronchoscope of an opaque medium such as iodized oil.

4. The roentgenographic appearance of pulmonary neoplasm is the result of its origin, and the secondary changes taking place because of its presence.

BIBLIOGRAPHY

(1) FARRELL, J. T., JR.: Roentgen Appearance of the Chest after Rib Resection for Pulmonary Abscess. Jour. Am. Med. Assn., 1931, XCVII, 1939.

(2) MANGES, W. F.: Roentgen-ray Diagnosis of Non-opaque Foreign Bodies in the Air Passages. Am. Jour. Roentgenol., 1922, IX, 288.

(3) FARRELL, J. T., JR.: The Roentgen Diagnosis of Intrathoracic Neoplasms. RADIOLOGY, July, 1929, XIII, 1.

(4) MANGES, W. F.: Non-opaque Foreign Bodies in the Air Passages: X-ray Diagnosis and Localization. Brit. Jour. Radiol., April, 1926, XXXI, 119.

PULMONARY ABSCESS, BRONCHIECTASIS, AND PULMONARY NEOPLASMS: BRONCHOSCOPIC ASPECTS[1]

By LOUIS H. CLERF, M.D., PHILADELPHIA

FINDINGS based on objective data are of the utmost value in diagnosis. Positive findings are always important; negative findings are usually of little importance although they may be of aid in helping one to arrive at a diagnosis by exclusion. In the diagnosis of pulmonary diseases, bronchoscopy should be considered as one of the important aids, since much of the information secured by bronchoscopic examination is based on objective evidence. Although it must be remembered that the entire lungs are not open to inspection, it is possible to see into the larger bronchi, to inspect the orifices of the smaller subdivisions, and to remove secretions from them. Bronchial obstruction affords one of the most important fields for bronchoscopy in diagnosis and treatment. The presence of obstruction to a bronchus, the nature of the obstruction, and, very often, its extent can be determined. Often, the obstruction can be removed by bronchoscopy.

In pulmonary abscess, the internist and roentgenologist usually encounter no difficulties in diagnosis or localization. In certain obscure cases which may be complicated by endobronchial lesions, bronchoscopy is of inestimable value. Localization of the abscess with relation to the lobes of the lung, particularly the lower part of the right upper or the upper part of the middle or lower lobes, may be confusing. Usually no difficulty is encountered bronchoscopically for the orifices of the individual lobes may be readily inspected and the presence or absence

[1]Read before the Radiological Society of North America, at the Seventeenth Annual Meeting, at St. Louis, Nov. 30–Dec. 4, 1931.

of pus noted. Pneumonography for the localization of pulmonary abscess can be successfully done only by bronchoscopic aid under fluoroscopic guidance. It is practically impossible for iodized oil, aided by gravitation, to spontaneously enter an abscess cavity which is incapable of emptying itself of pus.

It is unnecessary here to discuss the principles underlying recovery from pulmonary abscess except to state that spontaneous recovery occurs only after adequate drainage has been established and maintained. In a certain proportion of cases this cannot be accomplished by the usual medical measures. Drainage from an abscess is most commonly interfered with by obstruction of the bronchus with granulations, thick, inspissated secretion, inflammatory mucous membrane, and over-loaded cilia. By bronchoscopy these mechanical blocks can be removed and this may be repeated two, three, or even four times weekly if necessary. Very remarkable results have been secured at the Bronchoscopic Clinic in the treatment of a large number of cases of pulmonary abscess by bronchoscopic aspiration supplementing medical treatment.

Not every case of abscess of the lung is suitable for bronchoscopic treatment, but no absolute rules can be formulated except in a very general manner. Cases should be considered individually and studied in consultation by the internist, roentgenologist, bronchoscopist, and surgeon.

Advanced bronchiectasis, particularly if bilateral and associated with nasal accessory sinus disease, presents no problem in diagnosis. Difficulties are met with in early bronchiectasis, in bronchial obstruction and in cases of questionable bilateral bronchiectasis in which surgical treatment may be indicated. It must be remembered that bronchiectasis involving only large bronchi is exceedingly rare. The smaller bronchi are commonly first involved; only in very extensive bronchiectasis does one observe enlargement of the larger bronchi. From a bronchoscopic viewpoint one cannot, therefore, positively diagnose very early bronchiectasis since one cannot inspect the minute bronchi. In these cases, however, one may suspect bronchiectasis from the condition of the bronchial mucosa, the condition of the bronchial spurs, and the presence of pus in the smaller bronchi. A positive diagnosis can be made only on the roentgen findings following the use of iodized oil, preferably instilled bronchoscopically. In certain cases of unilateral bronchiectasis it is difficult to positively rule out disease of the opposite lung. The importance of this is obvious if surgical treatment is contemplated. Mucosal infection due to spilling over of pus is common on the opposite side. Pneumonography and often preliminary bronchoscopic aspiration is indispensable in these cases.

Obstruction of a bronchus is usually recognized by physical examination and roentgen study: it is often impossible, however, to determine the cause of the obstruction and the condition of the bronchial tree distal to the point of obstruction. This can be readily understood when one considers the large number of conditions that may produce blocking of a bronchus. As previously stated, it is possible, by bronchoscopy, to recognize the presence of bronchial obstruction, to observe the nature of the obstruction and very often its extent. In many instances the obstruction can be removed. This has been repeatedly done with foreign body obstruction, with benign and in certain malignant neoplasms, and occasionally with broncholiths. In cicatricial stenosis, the stricture may be dilated and in compression stenosis additional data may be secured to aid in the diagnosis.

It is important to realize that practically all forms of bronchial obstruction will ultimately be followed by bronchiectasis of the branches distal to the obstruction—in these

cases bronchoscopic pneumonography is the only positive means of diagnosis. In the presence of pus one should use iodized or brominized oil; to demonstrate a stricture good results can be secured by the bronchoscopic insufflation of bismuth subcarbonate.

In the treatment of bronchiectasis, bronchoscopy is of aid to the surgeon in preoperative and post-operative aspiration of certain cases. In bilateral cases of bronchiectasis, it is of aid to the internist in that it helps the patient to get rid of pus, improves drainage, decreases fetor and improves the condition of the mucous membranes. Its greatest field of usefulness lies in the treatment of bronchiectasis in children.

Since pulmonary neoplasms are commonly of bronchial origin and more frequently occur in the larger bronchi, a positive early diagnosis may often be made by bronchoscopy. In the endobronchial forms, tissue may be removed for histological examination. In cases of involvement of the smaller bronchi, with compression stenosis of the large bronchi but without intrusion of the growth, the bronchoscopist can often detect rigidity and fixity of the bronchial wall. This is observed only in infiltrative lesions and can be accepted as positive evidence of malignancy.

Several cases of successful bronchoscopic removal of cancer of the bronchus have been reported. Radon seeds may be implanted directly into the growth, as advocated by Jackson. Unless the bronchial obstruction is promptly relieved by treatment or by removal of the growth, secretions will stagnate and infection occur distal to the growth and bronchiectasis will ultimately develop. Recently, in several cases of globular growths occluding a bronchus, I have removed the tumor and then fulgurated the base with satisfactory results so far as the patient's cough and expectoration were concerned. This was done in conjunction with deep roentgen therapy.

BIBLIOGRAPHY

1. Flick, J. B., Clerf, L. H., Funk, E. H., and Farrell, J. T., Jr.: Pulmonary Abscess: An Analysis of 172 Cases. Arch. Surg., December, 1929, XIX, 1292.
2. Clerf, L. H.: Lung Abscess Following Tonsillectomy: Report on Series of 58 Cases. Atlantic Med. Jour., September, 1928.
3. Jackson, Chevalier: Post-tonsillectomic Pulmonary Abscess. Atlantic Med. Jour., February, 1926, XXIX, 309.
4. Clerf, L. H.: Bronchoscopic Aspects in the Diagnosis of Non-tuberculous Pulmonary Disease. Atlantic Med. Jour., September, 1926, XXIX, 839.

PULMONARY ABSCESS, BRONCHIECTASIS, AND PULMONARY NEOPLASMS: SURGICAL ASPECTS[1]

By JOHN B. FLICK, M.D., Philadelphia

THE chief indication for surgical intervention in the treatment of pulmonary abscess is the failure of conservative measures to bring about a cure within a reasonable period of time. Perhaps only when the abscess is close to the chest wall, with pleural involvement, or when it is very large and the patient extremely ill, are we justified in resorting to operation without first trying other methods of treatment. Experience has shown that a large percentage of patients suffering from abscess of the lung are cured by postural drainage, bronchoscopy, and general supportive measures. The determination of the proper time for operation is important, as external drainage during the acute phase of the disease may be followed by a wide extension of the pneumonic process (1). Abscesses with markedly fibrosed walls almost certainly will require operation, but nothing is lost and often a great deal gained by bronchoscopic drain-

[1]Read before the Radiological Society of North America, at the Seventeenth Annual Meeting, at St. Louis, Nov. 30–Dec. 4, 1931.

age and other remedial measures until the maximum benefit of such treatment has been obtained. The selection of the case and the determination of the proper time for operation is largely a matter of judgment and cannot be governed by hard and fast rules.

Exact localization is of the utmost importance to the surgeon in planning the exposure of the abscess, and this is best accomplished by a joint consideration of the case with the internist, roentgenologist, and bronchoscopist. Whether an abscess is in the upper part of a lower lobe or in the lower part of an upper lobe or in the middle lobe cannot always be determined by physical signs and roentgenograms. The bronchoscopist, who is able to observe from which bronchial division pus comes, can usually settle the point in question.

An antero-lateral exposure is the best for most upper lobe abscesses. In abscesses of the lower lobe, the approach should be posterior or postero-lateral, and in abscesses of the middle lobe, antero-lateral.

Local anesthesia, alone or in combination with nitrous oxide analgesia, is preferable to general anesthesia for obvious reasons. Occasionally we have used avertin, supplemented by nitrous oxide or local anesthesia, but avertin is objectionable because it diminishes the cough reflex for too long a time. Morphine given by hypodermic injection half an hour before operation is useful in quieting the patient.

An ample exposure of the involved area of lung is necessary to the successful handling of this condition. This is accomplished by the subperiosteal resection of three or four inches (7 or 10 cm.) of two or more ribs, depending upon the size and location of the abscess, followed by removal of the intervening intercostal structures and the periosteum of at least one rib. The abscess is widely opened and the cavity dealt with under direct vision. In most instances the operation is done in two stages, but in cases in which obliteration of the pleural space already exists the abscess may be opened at once. Even when adhesions are present it is advantageous to do the operation in two stages. An interval of a few days allows the lymphatics to become sealed and the ends of the resected ribs more or less covered before the wound is bathed in pus. A plain gauze pack left in the wound for a week or ten days will cause the pleural surfaces to become firmly adherent. The introduction of sutures for this purpose is neither safe nor necessary.

If the abscess is superficial, the outer wall should be removed, for which purpose the endothermic knife is ideal. Bleeding is almost negligible and may be controlled by changing from the cutting to the coagulating current. Bleeding points are clamped and the coagulating current passed down the hemostatic forceps. In abscesses of long duration, with sclerotic walls and small pockets, it is necessary to remove or destroy the wall of the abscess in stages. This can be accomplished with the endothermic knife, with the electric cautery, or with the soldering iron after the method of Graham (2).

Obliteration of the abscess cavity depends on contraction of its wall and on expansion of the lung. The removal of a sufficient amount of rib and the destruction of the wall, in abscesses of long duration, are essential points. The type of pulmonary abscess which in the roentgenograms shows a well defined cavity with little change in the surrounding pulmonary tissue is more easily cured by operation than that which shows dense shadows and a less conspicuous cavity.

After opening the abscess, or removing the outer wall as the case may be, the cavity should be packed with gauze. Gauze packing does not interfere with drainage and obstructs the open bronchi so that the patient can cough effectively. This, we believe, is important in lessening the occurrence of the pulmonary complications which sometimes follow the free opening of a large abscess.

Obliteration of the cavity in pulmonary

abscess often does not keep pace with the healing of the external wound. In such cases, the scar should be excised, the diseased area again exposed, and further cauterization done. It may be necessary to repeat this procedure several times, but each time the cavity is smaller and finally the remaining fistulas close, with the healing of the external wound. If a fistula persists after symptoms of infection have subsided, it can be closed with a pedicle graft of muscle (3) (4).

The patients who require operation are those who have failed to respond to other forms of treatment and who will in all probability die from the disease without surgical intervention. The mortality in this group, even with operation, is high. In 1929 we reported the results in 29 cases treated surgically (5). Nine patients (31 per cent) completely recovered and 10 patients (34.4 per cent) died.[2] One-half of the deaths were due to intracranial complications. The high incidence of intracranial lesions in patients with pulmonary abscess is due to emboli originating in the lungs. Veins, with which the lungs are abundantly supplied, are involved in the destructive inflammatory process and become thrombosed. The constant movement of the lungs and the trauma of cough favor the dislodgment of emboli, which are carried into the cerebral circulation. Twice in our experience cerebral embolism has occurred on the operating table and we believe that the utmost gentleness is necessary in operating for pulmonary abscess in order to minimize the danger of this complication.

Bronchiectasis.—The surgical procedures at our disposal for the treatment of bronchiectasis fall into one of two classes: those which aim to bring about collapse of the involved pulmonary tissue and those which have for their object the removal of the diseased part of the lung. The former comprise artificial pneumothorax, phrenic neurectomy, and extraplural thoracoplasty. The latter are the various forms of lobectomy and cautery pneumectomy (Graham).

Collapse therapy puts the lung partially at rest and in a favorable condition for contraction of fibrous tissue in the involved areas, with consequent diminution in the size of the bronchial dilatations. It is, of course, limited to cases of unilateral disease.

Artificial pneumothorax probably should be tried in early cases, especially in children, but offers only a small chance for cure. It has the disadvantage that it must be continued for a long period of time. Whittemore and Balboni (6) report one case cured by artificial pneumothorax out of five cases so treated. They summarize 93 cases taken from the literature, with 14 (15 per cent) reported cured and 44 reported improved (varying from slight to really great improvement). Only seven patients were reported as having died, and of these, two died following thoracoplasty. There was a rupture into the pleural cavity in only three.

They say:

"We do not feel any great amount of confidence in the use of artificial pneumothorax in cases of bronchiectasis, although the literature reports a cure in 15 per cent of the cases; but we are willing to believe that in a rare case which is taken early and in which there are no adhesions, the patient may be cured. We believe also that occasionally a patient may be kept free from symptoms for as long a time as a complete collapse of the lung can be maintained."

Phrenic neurectomy, judging from the literature, gives sufficiently good results to warrant its use in almost every case of early unilateral bronchiectasis. It is an operation easily and safely performed. Our own experience with it has been rather disappoint-

[2] Of the remaining 10 cases, three patients recovered with bronchial fistulas, making a total of 12 patients (41.3 per cent) who were able to return to work. Six patients were still under treatment and one unimproved. The same group was followed and a year later 10 of these patients (34.4 per cent) were free from symptoms and had healed wounds; 12 (41.4 per cent) were dead; three had bronchial fistulas; one was healed but occasionally spat blood; three could not be traced but two of these were considered in the first report as having recovered.

ing, but we are not able to give our own statistics at the present time. We have had patients improve after phrenic neurectomy in conjunction with bronchoscopic treatments, but have had no cures. Hedblom (7) reports his experience with a series of 38 cases, nine of which remained symptom-free for from three months to three years, and other surgeons have reported cures.

Extra-pleural thoracoplasty brings about collapse of the lung, the extent of which may be made to approximate that secured by artificial pneumothorax if a sufficient amount of rib is removed. The ordinary paravertebral extra-pleural thoracoplasty collapses the upper lobes as well as the lower and does not sufficiently collapse the lower lobe. The operation practised by Hedblom, who is the chief advocate of this form of treatment when the more conservative measures fail, is a subperiosteal resection in multiple stages of almost the entire length of the ribs from the third or fourth rib down to and including the eleventh rib. Hedblom has recently reported a total of 32 cases treated by this method: three of these patients have been symptom-free for at least five years after operation; 19 have shown improvement; six were improved but died later from various causes; four died within a few weeks of operation. Hedblom says the most favorable type is the case with an early peripheral unilateral cylindrical lesion. He believes that the unsatisfactory results reported by others are probably due to operations which fail to secure complete collapse of the diseased portion of the lung. Some of our patients have shown marked improvement following thoracoplasty, but we do not believe it is the operation of choice except in extensive multilobar unilateral cases.

There are many things to consider in deciding upon the proper surgical procedure for the individual patient. It is obvious that in most cases of bronchiectasis any procedure short of removal of the diseased tissue will not be curative. One must consider the rather great immediate risk of a radical operation which, if the patient survives, offers a good prospect for cure, as contrasted with the slight immediate risk of a palliative operation which leaves the patient with the disease only held in abeyance. With the palliative operation, it must be remembered, there still is a remote risk from the remaining diseased tissue.

Lobectomy is the ideal treatment, but the high mortality has made surgeons hesitate to advise it. Prolonged sepsis prior to operation has had much to do with this high death rate. Recently the mortality has been lowered in carefully selected cases, and we believe will before long compare favorably with that of other operations for equally serious conditions. Artificial pneumothorax, phrenic neurectomy, thoracoplasty, and cautery pneumectomy no doubt will always have a place in the treatment of this condition, but with early diagnosis made possible by modern methods a greater number of cases of bronchiectasis will be found suitable for lobectomy.

Resection of the ribs over the involved lobe and cautery destruction of the diseased portions of the lung in stages has been carried out successfully by Graham and others, an operation particularly appropriate in those cases with an extensively diseased and adherent lobe. Graham (8) has reported 20 cases of "chronic pulmonary suppuration" so treated. Six patients (30 per cent) were free from symptoms and completely healed; four (20 per cent) were free from symptoms but had bronchial fistulas; three (15 per cent) showed marked improvement but still had some cough; two (10 per cent) were improved but had not left the hospital; four (20 per cent) died, and one patient could not be traced.

Spirochetes appear to play a conspicuous part in the bacteriology and pathology of bronchiectasis as well as in pulmonary abscess. Perhaps the future holds in store

some specific drug which will eradicate this stubborn infection and thus simplify the treatment of these conditions.

Malignant Neoplasms of the Bronchus.—Primary malignant neoplasms of the bronchus, from the surgeon's viewpoint, may be divided into two classes; those which arise so close to a main bronchus as to put them beyond the pale of surgical measures of to-day, and those which arise from the bronchial subdivisions, apparently within a lobe of the lung, which, if diagnosed early, are suitable for surgical intervention. The advances made in thoracic surgery in recent years demand an early recognition of the latter cases, so that the surgeon may determine by actual experience the worth of radical removal of the tumor. That this is feasible has been shown by reported cases, but the great difficulty lies in the late diagnosis of the condition with the probability that metastasis has already occurred. Lobectomy for early bronchial neoplasm situated within a lobe, because of the absence of infection, should cause a decidedly lower mortality than when it is performed for bronchiectasis.

The question of metastasis, aside from involvement of the regional lymph nodes, is important and difficult. Apparently intracranial metastases are common. Thus Fried and Buckley (9) in 38 proved cases of carcinoma of the lungs which they observed, reported 15 in which metastasis to the central nervous system was verified either at operation or at necropsy. They say that a tumor embolus from a pulmonary cancer in all probability passes from the pulmonary vein directly into the cerebral circulation, whereas cancer emboli from other viscera are primarily retained by the lungs, where they may remain indefinitely, often being altogether destroyed. We have never seen at operation a case of malignant bronchial neoplasm that would permit of radical extirpation of the growth, but in the cases that we have explored, removing a piece of tissue with the endothermic knife for microscopic study, there has been no infection, and the patients have recovered promptly from the operation. Edward D. Churchill has successfully operated on a case of carcinoma of the bronchus in which he removed the middle and lower lobes (10).

Bronchial neoplasms not infrequently cause pulmonary abscess by obstructing the bronchus from which they spring. Here surgical intervention is only palliative but it is justified because of the relief from symptoms which external drainage of the abscess gives, and there may be some advantage in applying the roentgen rays directly to the area exposed by operation.

Unfortunately, in the majority of cases suitable for radical surgical intervention from the standpoint of location of the growth, the growth cannot be seen through the bronchoscope and is situated in an area of the lung, which, until too late, is silent as far as any marked symptoms are concerned. It seems to us that only by keeping the possibility of bronchial newgrowth in mind and by diligently studying patients with vague pulmonary symptoms will progress be made in the surgical treatment of this condition. If repeated roentgenograms taken over a reasonable period of time show a suggestive shadow, and if the bronchoscopist cannot see a growth in the bronchus, other conditions being excluded, surgical exploration of the chest is indicated. With the present development of thoracic surgery, exploration should be comparatively safe, and, if the growth is discovered early, radical removal should be feasible.

BIBLIOGRAPHY

(1) Miller, J. A., and Lambert, A. V. S.: Treatment of Abscess of the Lung. Am. Jour. Med. Sci., January, 1926, CLXXI, 88.

(2) Graham, E. A.: Rôle of Surgery in Treatment of Pulmonary Suppuration. Jour. Am. Med. Assn., July 18, 1925, LXXXV, 181.

(3) Scrimger, F. A. C.: Case of Abscess of Lung, with Filling of Cavity and Closure of Bronchial Fistula by Pedicle Muscle Graft.

Arch. Surg., December, 1929, XIX, Pt. 2, p. 1313, 1314.
(4) ALEXANDER, J., and BUCKINGHAM, W. W.: Treatment of Non-tuberculous Suppurative Pneumonitis, Abscess and Bronchiectasis. Jour. Am. Med. Assn., Nov. 15, 1930, XCV, 1481.
(5) FLICK, J. B., CLERF, L. H., FUNK, E. H., and FARRELL, J. T., JR.: Pulmonary Abscess: Analysis of 172 Cases. Arch. Surg., December, 1929, XIX, Pt. 2, p. 1292-1312.
(6) WHITTEMORE, W., and BALBONI, G. M.: Non-tuberculous Bronchopulmonary Suppurative Lesions: Results of Treatment by Artificial Pneumothorax. Arch. Surg., January, 1928, XVI, Pt. 2, p. 228-278.
(7) HEDBLOM, C. A.: Pathogenesis, Diagnosis, and Treatment of Bronchiectasis. Surg., Gynec. and Obst., February, 1931, LII, Pt. 2A, p. 406.
(8) GRAHAM, E. A.: Cautery Pneumectomy for Chronic Suppuration of Lung. Arch. Surg., January, 1925, X, Pt. 2, p. 392-418.
(9) FRIED, B. M., and BUCKLEY, R. C.: Primary Carcinoma of the Lungs. Arch. Path., February, 1930, IX, 483.
(10) CHURCHILL, EDWARD D.: Personal communication.

DISCUSSION

DR. EVARTS A. GRAHAM (St. Louis): There are so many points to take up in regard to the various subjects which have been presented here that, of course, it is obviously impossible to do any more than touch briefly upon certain features. I shall confine myself for the most part to the question of treatment of these conditions, because it is in that I happen to be most interested.

First of all, I would like to say a word or two in regard to nasal sinus infections with reference to chronic pulmonary suppuration, bronchiectasis, or chronic cough, or any other chronic condition associated with the lung. I believe that this association was first mentioned by Sergent, in France, about 1920 or 1921. We have been interested in this matter for a good many years, since having our attention called to it by Sergent. I am sorry to say, however, that we have not noticed the improvement which we had hoped to get in cases of pulmonary suppuration after treatment of the nasal sinuses. We have seen patients who have been improved, as far as the cough is concerned, for variable periods of time, and perhaps for as long as a year, sometimes two years. But almost inevitably, if the patient has a definite bronchiectasis, the symptoms are sure to return.

We had one patient who went for a period of about two years with great improvement and with almost cessation of cough and sputum after radical treatment of chronically diseased nasal sinuses, but I understand that subsequently her symptoms returned.

An interesting relationship, however, exists between the upper respiratory tract and the lower respiratory tract. In patients who have bronchial fistulæ we have observed frequently that the onset of an acute coryza in the upper respiratory tract will invariably cause the bronchial fistula to become red and swollen, and to begin to secrete. This will sometimes pour out voluminously from the bronchial fistula as soon as the coryza has been well established in the upper respiratory tract.

This shows, I think, in a very interesting manner, and quite conclusively, that patients who have bronchiectasis are very likely to have their symptoms aggravated by minor infections of the upper respiratory tract. I believe, therefore, that the upper respiratory tract should be treated, because, when we have a patient who has a well marked bronchiectasis, any improvement which we can accomplish toward the cessation or diminution of the troublesome cough or sputum, even if only for a short period of time, is welcome.

There is one phase of chronic abscess, or chronic bronchiectasis, several examples of which have come to our attention within the last two or three years. These are cases which seem to be primarily congenital cysts of the lung. They are carried by the patient without symptoms perhaps for a good many years—then infection occurs. The patients present the most remarkable x-ray films that one can possibly imagine if he has not already been acquainted with that condition. The whole lobe, and in some cases the whole lung, will be involved by enormous cavities, which are easily demonstrated after lipiodol injection.

We have seen this condition several times in infants; in one case in an infant only 48 hours old, and in several cases in infants slightly older than that. We have had them all the way up to adulthood. We have a young man at present in the Barnes Hospital who is about 30 years of age, who presents what

seems undoubtedly to be an infection of a congenital cystic lower lobe. These are the cases which are sometimes described as congenital bronchiectasis. It is, perhaps, bronchiectasis of a sort, but not what we ordinarily think of when we use that term. The treatment of these conditions, however, is exceedingly troublesome, at least in our experience.

There is one other feature in regard to the surgical treatment of lung abscess, subacute lung abscess or acute lung abscess, which Dr. Flick could not mention because of the wide territory he had to cover in a short space of time. That concerns the combination of empyema with lung abscess. I believe that Dr. Clerf referred to it very briefly in his paper. In our experience, empyema, instead of being a serious complication of lung abscess, as I believe is ordinarily supposed, has usually turned out to be a very fortunate complication. That is to say, almost invariably in our experience patients who have a lung abscess and have developed empyema have made a very rapid and prompt recovery, not only of the empyema but of the lung abscess, simply by external drainage of the empyema.

The literature on this subject, a number of years ago, led us to believe that the occurrence of an empyema was a complication which should be much dreaded. Of course, it is a complication which we do not desire. Nevertheless, in our experience, those cases of lung abscess which have developed an empyema spontaneously before we have seen them have, I think, invariably recovered. I think there has not been a single exception to that, unless the case happens to be complicated by carcinoma. This, of course, greatly simplifies the treatment of lung abscess, because usually all that is necessary is to confine your attention to the empyema and not to worry very much about the pulmonary abscess.

Dr. Flick mentioned phrenic neurectomy in bronchiectasis, saying his results had not been particularly encouraging. That is exactly the experience which we have had. We have performed phrenic neurectomy, I think, in about 25 cases of lower lobe bronchiectasis, in which the operation ought to have had the most favorable results. Of that number only one or two cases have shown anything that could be called very decisive improvement. There have been some patients who have been made distinctly worse, because it has been more difficult for them to empty themselves by the act of coughing after the diaphragm has been paralyzed. Three patients of this series have died within the next few months of extensive suppurative pneumonia, which I think was due entirely to the fact that they were less able to empty themselves by coughing after the phrenic neurectomy than they had been before. In other words, although it is a simple operation which is now being performed in a very large number of cases throughout the country, I think that it is one which, despite the simplicity of the operation itself, may carry a considerable amount of danger to the patient afterwards. There may be occasional dramatic successes from it, but perhaps on the whole it should be regarded, in the light of present experience at least, as an operation which is not likely to accomplish very much and which may do harm.

In regard to the treatment of acute lung abscess, I agree fully with everything that has been said here. I think that it is very necessary that everyone should adopt an attitude of mind about the treatment of lung abscess, which will consist for the most part of primary conservatism before surgical treatment is carried out. That holds for most abscesses. There are some, however, as Dr. Flick mentioned, in the periphery of the lung, which, for various reasons, had best first be drained surgically.

During the war, I happened to be a member of the empyema commission appointed by the surgeon general. We had an opportunity to study about 7,000 cases of so-called empyema. It was streptococcic empyema which occurred in the influenza epidemic in the winters of 1917 and 1918. We followed a great many of these patients to the autopsy table, and we found, almost without exception, that none of these patients who died failed to have one or more lung abscesses. The fact that at autopsy at least small abscesses were found in practically every case of streptococcal pneumonia convinced me that probably the majority of

persons who have lung abscesses get well, since there is a strong probability that most cases of streptococcal pneumonia have them. The majority of them are not recognized. I mean, the fact that they occurred so frequently during this influenza epidemic indicated that many of those persons who recovered from influenza also had lung abscesses from which they also recovered. Moreover, there is considerable evidence that, in many cases in which the patients developed empyema, they developed it after the rupture of a subpleural lung abscess into the pleural cavity.

I have been convinced, although I cannot produce satisfactory statistical evidence before you here this morning, that perhaps the majority of lung abscesses which recover spontaneously without any intervention of any kind pass along unrecognized. That has led me to be extremely conservative about the treatment of lung abscess. As long as I have been interested in this sort of work, I have adopted a conservative attitude, believing that the patient with a lung abscess should be given the benefit of an opportunity to recover spontaneously before surgical treatment is instituted. That offers many advantages, some of which were enumerated in an article by Miller and Lambert, of New York. If one operates too early on a case of pulmonary abscess, it means he will have to go through a soggy, edematous lung in order to reach the site of the abscess. This edematous tissue offers practically no resistance to infection, and, therefore, an extensive suppurative pneumonia is likely to occur because of the infection set up by the pus pouring out of the abscess cavity over the edematous tissue.

It is not surprising, therefore, that, in the early days before a full realization existed of the value of conservative treatment in pulmonary abscess, the surgical mortality was variously quoted as somewhere between 75 and 95 per cent. You will find statistical articles of that sort in the literature beginning probably in 1910 on to 1922 or 1923. Any procedure which carries a mortality of 90 per cent probably has something the matter with it. At least matters could not be much worse if you tried some other procedure.

I have no argument at all, or any quarrel of any sort, with regard to whether bronchoscopic treatment, or simply postural drainage, should be used during the period of watchful waiting, during the period when the abscess is forming itself definitely into an abscess, giving time for the surrounding edema to subside somewhat, waiting until such time as you have, perhaps, a definite pyogenic membrane around the abscess to help wall it off somewhat. Some patients respond to postural drainage, provided it is intelligently used. Others will not respond well to postural drainage. Such patients should certainly be treated by bronchoscopy, at least until the drainage is well started. If there is not a skilled bronchoscopist at hand, I believe it would be better to try postural drainage with these patients for a while, rather than bronchoscopy at the hands of a bunglesome bronchoscopist. I think Dr. Clerf will agree with me.

Dr. Flick also was kind enough to mention the procedure of cautery pneumectomy, which we have used in certain cases of chronic pulmonary suppuration. There are, unfortunately, types of chronic pulmonary disease which do not fit into the two categories which have been mentioned, simple chronic abscess and simple bronchiectasis. That is to say, we see conditions every now and then in which a lobe of the lung is riddled with small abscesses. If one exposes such a lung to inspection, he will find that there are many abscesses. They are not always confined to dilated bronchi; they are, however, usually associated with a bronchiectasis and with bronchial dilatation, but they are often in the parenchyma as well. The lobe of the lung does not crepitate. It feels more or less solid and presents a bluish red appearance. One can get pus at almost any place in such a lobe at which he inserts a needle or makes an incision. These cases do not do well under simple ordinary drainage, as a well-established abscess does. They are extremely dangerous from the standpoint of lobectomy. In fact, lobectomy in this sort of case has been almost 100 per cent fatal. They are not suitable for thoracoplasty, because in the series of six or eight cases which Hedblom described, in which

this type of procedure was followed, he had a mortality of 100 per cent. It is desirable to get rid of this lung tissue, however, because, unless we do, the prognosis is almost uniformly fatal.

In the light of all of these considerations, it seemed to me several years ago that perhaps the safest way to accomplish what we were after in this sort of case was to remove the abscess gradually by means of the cautery. We have performed this operation on 65 patients. I do not think that the operation is so applicable to the ordinary bronchiectasis of the chronic type as it is to cases of chronic abscess, and particularly to chronic abscess confined to one lobe.

There is one other point about which I wish to speak, carcinoma of the bronchus. I heartily subscribe to everything that Dr. Clerf said in regard to the value of the bronchoscope, not only in the diagnosis but also for the treatment of primary carcinoma of the bronchus. When these bronchial carcinomas are close up to the mediastinum, involving a main bronchus, I think the best chance that we have at present for a satisfactory removal of them (not only to relieve the bronchial obstruction, an important point which Dr. Clerf mentioned, but also to remove the carcinoma to give the patient a chance to recover) is through the bronchoscope.

I am going to ask Dr. Arbuckle, who happens to be here, to tell about the patient who has gone for over two years, following a successful removal of a carcinoma through the bronchoscope.

Dr. LeRoy Sante (St. Louis): Dr. Funk's paper certainly demonstrates to us as radiologists that the x-ray film of the chest must be interpreted in the light of the clinical symptoms. I am sure that many of the conditions he showed could not be identified without a clear understanding of them. This is subscribed to by practically all radiologists to-day.

Take, for instance, the similarity of lung abscess to actual tuberculous cavity. I have in mind one instance of a young girl who came to the St. Louis City Hospital from one of the tuberculosis dispensaries, where she had been in the hands of well qualified clinicians. I will admit that it was many years ago, before x-rays were used as often as they are now. This girl was treated for 18 months for a chronic cough, repeated expectorations of blood, frank hemorrhages, loss of weight, and so on, without a roentgenographic examination.

Her symptoms were: chronic cough, loss in weight, expectoration of purulent sputum, frequent hemorrhages, night sweats—a typical picture of tuberculous involvement. Yet roentgenographic examination disclosed a typical lung abscess.

Dr. Farrell's paper brought to my mind some observations that have engaged our attention recently. It has seemed to us that, especially in some chronic infections—tuberculosis, carcinoma, and so on—a great deal of the consolidation observed in the roentgenogram may not be actually due to infiltration or a pus-filled area, but may be the result of atelectasis.

I have in mind a patient who has been observed recently at St. Mary's Hospital, a middle-aged man who had been chronically ill with tuberculosis and who showed what appeared to be typical chronic interstitial pneumonia with fibrous tissue retraction. There was massive involvement, and yet a pneumothorax was easily performed. No adhesions were present and the heart immediately returned to its proper location. I am absolutely convinced that the greater part of the process in that man's lung was due to atelectasis.

The advent of atelectasis is something that we must always remember in our analysis of the roentgenogram. For instance, in tuberculous cases, all of us have encountered an area of rather homogeneous density in the apex. I feel confident that it is not actually tuberculous, but atelectasis associated with an obstruction of the upper smaller branches.

The matter of the filling of abscesses of the lung by intratracheal injections of opaque material has been a very difficult procedure with us. I frankly say that I have been unable, in any instance, to fill thoroughly an abscess of the lung by the injection method, unless it had been possible actually to introduce into

the abscess cavity a small ureteral catheter. We have found the introduction of this tool very satisfactory for the injection of lipiodol, although it is a bit more difficult and trying to the patient. By this method, under fluoroscopic control one is able to inject the lipiodol into just the areas he desires. In the early days, we used to flood the lower portion of the lung, using three or four bottles of material in order to be sure that we were not missing anything. We feel now that this is a big mistake, and we are not carrying out this procedure any longer.

Certain experiments on the injection of lipiodol into the pericardial sac have proven it to be an irritant when it is maintained in prolonged contact with a serous membrane. Lipiodol injected into the lung after a short time is drawn into the terminal alveolar structure. When this occurs, we have a feathery appearance resulting in the film, a finding which does not subside, in some cases, for many weeks or even months. Such prolonged contact cannot be beneficial.

When the lipiodol is injected into a bronchus, this rather viscid fluid goes down the bronchus until it comes to the smaller bronchial branches. You do not see the terminal bronchial structure, or the terminal alveolar structure, in the first injection. You will understand how impossible it is to see it if you take a narrow-necked bottle in which there is already air or fluid and try to pour water into it.

The same phenomenon is true of an abscess cavity. For instance, fill it with secretion and then try to pour in the lipiodol. You can not do it unless you insert a tube directly into it. The same is true of the terminal bronchial branch. How then is it finally expressed into these branches? The lipiodol injected into the bronchi comes down to this point at which it is obstructed, since there is air trapped in the terminal vesicle. If a bronchus, or any portion of the bronchial tree, is completely blocked, the air contained in the peripheral portion will be very rapidly absorbed by the circulating blood. The same process takes place here. Another film taken a half-hour after the first examination will show that the material has been drawn down into, and occupies, the very terminal alveolar structure. When it is in this position, absorption takes place very slowly.

As we have seen, when a serous surface is maintained in prolonged contact with lipiodol, evidence of irritation results. I do believe that it is a great mistake to flood the lung with large amounts of this material, even though it is only mildly irritating. Only the area under investigation should be examined. If this can be done by injection, all well and good. In most cases, bronchiectasis can thus be demonstrated. In this particular, introduction of the oil through a catheter, either by the bronchoscopic method or by its direct insertion into the trachea, offers two distinct advantages. One is the draining or sucking out of the material that is already there, or in the neighborhood, before the attempted introduction of the oil. The other is that the radiologist is enabled, under fluoroscopic control, actually and accurately to introduce the oil into the abscess cavity—a difficult and almost impossible thing to do unless the oil is injected through a catheter. The bronchoscopic method has one distinct advantage: it also gives an opportunity to observe other lesions that may have influenced the production of this infection.

The matter of bronchoscopic drainage after actual frank abscess of the lung seems to offer wonderful opportunities. When you recommend bronchoscopy, you think of it as a rather trying procedure, but I was much surprised and gratified to see the ease with which this examination can be made after the patient is accustomed to it. I recall a school boy who is undergoing this sort of treatment in Dr. Clerf's clinic. He comes in after school carrying his books, he lays them on the table, hangs his hat on a hook, and gets up on the bronchoscopic table. After the treatment, he hops off and goes home. It is really quite remarkable, and I imagine that the patients get so they can completely co-operate.

Dr. Clerf was modest in his statement of the spontaneous cure of abscess. While I am well aware that, perhaps, the majority of abscesses do undergo a spontaneous healing, and while I have observed the formation and complete regression in lung abscess in nine

days, still I feel that there is a certain percentage of these which, if allowed to become subacute or chronic, progress to permanent invalidism.

Has Dr. Flick any criterion which he can give us, as radiologists, upon which to base the surgical intervention in any given case of abscess formation? I realize, of course, that there must always be the period of conservative treatment that Dr. Graham has mentioned, but just when does this begin and when does it end? In other words, does he fix a certain period of time for these persons to get well by themselves? If we fix a more or less arbitrary period of three months, would that be too long? For instance, is there any danger, in attempting an operative procedure of this type, in going in when the infection is more acute?

Dr. M. F. Arbuckle (St. Louis): Before I talk about the case which Dr. Graham mentioned, I would just like to say a few words about the relationship of infectious sinusitis to bronchiectasis; first, with regard to the matter of diagnosis, and second, the treatment of sinus suppuration.

It has been my experience that many of these cases have multiple sinusitis, pansinusitis. I do not believe that the results are so satisfactory if only one or two sinuses are treated as they are if all the sinuses are treated. By that I mean surgical interference. After surgical treatment has been carried out, I think the necessity for long, persevering post-operative care is of great importance. There is much infection around the upper respiratory tract which is not within the sinus, which is liable to recur. I think that is important in the care of these cases.

Bronchoscopic treatment of bronchiectasis by suction and by application of various remedies has secured the same results for me as it has for Dr. Clerf and other bronchoscopists. After the removal of whatever secretion is possible, I have been in the habit of instilling into the dilated bronchus a solution of guaiacol in oil. I would like to hear Dr. Clerf's comments on this part of the treatment. It seems to me that the guaiacol in oil has a beneficial effect in that it helps to reduce the odor, which plays such an important part in the lives of these patients. It also helps to retard the formation of the characteristic large amounts of pus. By showing us how to pass flexible tubes around corners and around angles, many times the use of lipiodol has helped us to reach, with suction, multiple cavities in the lung. By some experimental work which we have carried out, we have been thus enabled to reach cavities formerly less easily accessible.

I remember the first experience I had with placing lipiodol in the lung for I had quite a shock when I looked at the roentgenogram. I thought that using the lipiodol under pressure had something to do with it, for we secured a film of a circumscribed area of drowned lung. A method of injecting lipiodol into the lung, which I have not heard discussed here to-day, was originated by Singer in our chest service. He simply pours the oil down. It is much simpler and easier than any other method of which I know. Of course, it is not available for all patients, but, in those cases in which the patient co-operates, it is satisfactory.

It is of the greatest importance to the patient that lung disease be diagnosed as early as possible, whether we are able to cure him or not. By bronchoscopic study we can make an early diagnosis, thus giving the individual the benefit of months, or longer, in which to arrange his affairs.

I have not seen the large percentage of endobronchial tumors, comparatively speaking, that the essayists report; more of them have been peribronchial. It may be that I have not been skillful enough to find them, but that has been my experience.

The bleeding at the time of bronchoscopic examination was to me, before I was initiated, very disconcerting. I discovered later that the bleeding was helpful, because, if you follow the trail, you finally come to the growth. Now I prefer that the patient shall bleed when I am trying to find the location.

Biopsy, of course, is very important in establishing a positive diagnosis. Electrocoagulation, I think, will come into its own in the field of treatment of these cases. These operations, in very sick individuals, are not without

a certain amount of shock to the patient; but, when we stop to consider what we are doing and what we are trying to accomplish for him, that is to be expected. I have seen serious results in only one case, and I think in that instance the procedure was ill advised. Even the sickest patients, in whom bronchoscopy is indicated, should have the benefit of careful consideration of the subject. The endobronchial application of radon implants to carcinoma of the bronchus, through the bronchoscope, is an effective means of destroying the growth locally. This can be done with little inconvenience to the patient and the subsequent reaction is not severe.

One case which Dr. Graham mentioned was that of a physician, whom we saw something over three years ago, who presented the symptoms of early carcinoma. By bronchoscopy I found a pedunculated mass obstructing the main bronchus (I have forgotten on which side), which had the appearance of carcinoma, and which, microscopically, was carcinoma. I removed all the mass that I could with the forceps, and then with the actual cautery destroyed the base. I am not certain whether or not I put a capsule of radium down in the bronchus, but he did receive deep x-ray therapy.

This man has been well and is carrying on his large practice. I am sure that if bronchoscopy had not been performed, he would not be practising with us now.

Dr. L. W. Dean (St. Louis): A number of systemic diseases are influenced by infections in the nasal sinus or throat. Arthritis and asthma, especially when they are due to bacterial allergy, and nephritis are influenced often by the removal of the nose or throat lesion.

When we have a systemic disease influenced by a tonsil infection or infection of a tooth, we can take the tonsil out, or we can extract the tooth and efface the infection about the socket. In this way, we get rid of the focus.

When we consider the pathology of nasal sinus disease, we find that the infection is not limited to the interior of the sinus, to the epithelium or the sub-epithelial tissue, or to the periosteum, but that it often extends into the bone. Consequently there is no operative procedure by means of which the focus of infection in and about a nasal sinus can be permanently eradicated in every instance. We cannot take out and throw away a nasal sinus as we do a tonsil or a tooth. Often we find in systemic disease associated with nasal sinusitis that operation on the sinus gives favorable results so far as the systemic disease is concerned, and then, with recurrence of the sinus infection, it becomes worse.

Before 1920 we reported the possible connection between nasal sinusitis and bronchiectasis.

In my judgment in bronchiectasis, if there is an improvement in the lung lesion which persists for months following an operation for nasal sinus disease and then the bronchiectasis becomes as bad as before, you will find that there has been a return of the nasal sinus disease.

Dr. Merl L. Pindell (Los Angeles): I agree with the authors that there should be a clearer clinical conception of the various pathologic conditions that are commonly designated as lung suppuration. If we had such team-work on all our cases as has been displayed here to-day, I am sure a change would be made for the better.

It is impossible, in such a short period, to discuss such an important and varied subject. All I desire to do is to cite a case I think *apropos* at this time. This particular patient, who came to my attention a few months ago, was considered to have a lung abscess. It was a unilateral basal condition, with a few densities around the cavity simulating tuberculous lesions, and, as the clinician suspected tuberculosis from the history, he proceeded to prove or disprove our contention. Over a period of six weeks, he received from the laboratory ten consecutive negative sputum reports for the acid-fast bacilli, one negative guinea pig inoculation, and one negative culture, and the patient gave a negative reaction to 0.1 mg. of tuberculin (Mantoux test). However, the clinician did not give up but continued the sputum examinations. He then received a series of positive sputum reports,

and the patient (three months later) is in a moribund condition due to tuberculosis.

I cite this case to show how careful we should be before planning treatment, as has so ably been brought out in this discussion.

DR. FUNK (closing): We believe that there are really no contra-indications to skilled bronchoscopy when aortic aneurysm has been excluded. We do not recommend bronchoscopy in tuberculosis, but not infrequently it has been our experience that, when the diagnosis of tuberculosis is in doubt, bronchoscopy establishes definitely its presence or absence.

In several patients recently, tuberculosis had been excluded because, on several examinations, the purulent sputum showed no tubercle bacilli, although signs of advanced pulmonary disease suggested tuberculosis. Following bronchoscopic examination and the aspiration of bronchial secretions, the laboratory report came back with the notation "Numerous tubercle bacilli." In this group none has reacted unfavorably to the bronchoscopy.

DR. FARRELL (closing): Both Dr. Graham and Dr. Chamberlain have mentioned congenital cystic disease in the differential diagnosis. Congenital cystic disease of the lung is rare, if one thinks of it as occurring as multiple cysts or as a solitary cyst. I recall one film which I presented before this Society of a solitary cyst of the left lower lobe showing a fluid level after it had been drained through the bronchoscope.[1] This is certainly the more common type, not being ordinarily confused with abscess, bronchiectasis, or newgrowth.

In multiple cystic disease of the lung, up to the time that the cysts are ruptured and their contents evacuated, the roentgenogram should reveal, scattered throughout the lung fields, rounded densities of size and number depending upon the size and number of cysts present. Only after rupture of the wall and drainage into a bronchus can iodized oil, or any other opaque medium, enter them. These multiple congenital cysts should be bilateral. This appears to me sound reasoning; but it is theoretic entirely; I have never seen a proven case of congenital multiple cystic disease in an adult.

However, I have seen reports in the literature of congenital multiple cystic disease of the lung. I am sure that in most instances the lesion was bronchiectasis of obstructive origin and not true cystic disease of the lung, because it was usually unilateral and associated with the displacement phenomenon of atelectasis. One slide that I used this morning showed numerous cavities scattered throughout both lungs. Another of the same patient was a pneumonogram showing the bronchoscopically instilled iodized oil in the cavities. I considered this a bronchiectasis. I wonder now if I were not wrong. Might it not be a case of true congenital cystic disease of the lung after rupture of the cysts and drainage through the bronchi? It does not seem to me now we would have this film otherwise. The pools with the iodized oil are crescentic in outline, thin walled, and scattered throughout both lungs. There is no evidence of marked inflammatory change between the pools. Certainly, this is not the usual appearance of bronchiectasis, for bronchiectasis is characterized by cavities so poorly defined and buried in such dense tissue that they cannot be recognized unless filled with an opaque material.

In speaking of the instillation of iodized oil, Dr. Arbuckle recalled to my mind a practical point. Nothing abnormal will ever be revealed by the instillation of iodized oil in an area in which anteroposterior or lateral roentgenograms, made before instillation of oil, evidenced no pathologic change. This fact and the fact that, from diseased areas, iodized oil is ordinarily more promptly evacuated than from normal lung tissue are important differential points to be borne in mind in the interpretation of pneumonograms.

DR. CLERF (closing): Pulmonary hemorrhage is not an absolute contra-indication to bronchoscopy; it may be a definite indication for a diagnostic bronchoscopy. I do not believe that bronchoscopy in itself could be considered a cause of serious pulmonary hemorrhage. I believe that bronchoscopy is def-

[1] The Roentgen Diagnosis of Intrathoracic Neoplasms, Figs. 1-*A* and 1-*B*. RADIOLOGY, July, 1929, XIII, 1.

initely contra-indicated at the time of hemorrhage, particularly if it is profuse, or immediately thereafter, unless it is believed that, by bronchoscopy, the hemorrhage may be controlled.

I am not certain that endobronchial medication plays a very important part in the treatment of pulmonary suppuration. Although we frequently instill some medicament, it must be admitted that the benefit derived from bronchoscopy lies in the aspiration of pus. Lung mapping, or pneumonography, may be considered a controversial subject so far as the method of introduction is concerned. We are all agreed that it affords one of the most important contributions in chest diagnosis. I believe that one should perfect oneself in the use of a particular method. Personally I am convinced that the bronchoscopic method is the superior one, since it permits accurate placement of the opaque material and also gives information which can be secured only by direct examination.

DR. FLICK (closing): The condition with which Dr. Graham has had to deal is neither bronchiectasis nor pulmonary abscess, but a combination of the two disease processes. These patients invariably die from the disease unless something can be done for them surgically. They are the most difficult cases of all in which to obtain results.

Dr. Sante asked about the proper time for operation in pulmonary abscess. We know that it is a dangerous thing to operate during the acute phase of the disease. External drainage at such a time may cause a widespread pneumonitis. If the patients are not doing well under conservative treatment, we consider operation. The individual case has to be judged on its merits. We are inclined to try everything else before resorting to external drainage, keeping in mind the fact that we must not delay too long.

The patient about whom Dr. Chamberlain inquired, who presented unilateral diffuse bronchiectasis, developed the lesion following the aspiration of a coffee bean. The thought did not occur to us that we might be dealing with a case of congenital cysts of the lung. The patient is one of our best results from thoracoplasty for bronchiectasis, although she had a very extensive disease. She has almost no expectoration and is able to perform her household duties and to live a comparatively comfortable life.

THE THYMUS

MORE RECENT FINDINGS AS TO FUNCTION AND THERAPY

By LEWIS J. FRIEDMAN, M.D., Roentgenologist, Bellevue Hospital, and Radiologist, German Polyclinic, NEW YORK

ANATOMY

THE thymus gland, as is familiar to all my readers, is a ductless organ of epithelial origin. The greater bulk consists of lymphoid tissue, in which infiltration occurs in early intra-uterine life. Usually the thymus is made up of two lateral lobes, but, occasionally, a median lobe is observed. The gland is seen as early as the second month of intra-uterine life and rudiments of it are visible in adults. According to some investigators, the progressive development continues until puberty; others believe that the gland matures in the second year, after which gradual involution of the cortex and, later, of the medulla take place. Hassall's corpuscles are last to show any changes of involution.

While the weight of the gland varies within certain limits, the normal average is about 10 grams. Abnormal weights of as high as 150 gm. have been reported at postmortem examinations.

The actual function of the thymus may properly be said to be shrouded in mystery. The possibility that the gland supplies an internal secretion has been asserted (Sajoue) and challenged by reliable investigators. Its extirpation in the dog is borne well, the animal exhibiting no detectable ill-effects in either growth or other normal physiologic functions. In contrast to this experiment, Miyagawa and Wada (1) observed an increase in weight in white rats and dogs when small doses (0.05 gm. per kilogram) of the cell constituents of calf's thymus were administered; with larger doses (1 to 2 gm. per kilogram) growth and development were retarded.

A moderate hyperplasia of the thymus has been observed during thyroidectomy, suggesting a possible synergy. The exact relation of the thymus to the thyroid in toxic goiter can be only conjectured.

The percentage of infants observed with upper mediastinal widening varies with different investigators. Perkins (2) reported 8 per cent of 237 routine examinations of which less than half were definitely thymic.

Raue and Fischer (3), who studied 100 infants (within 48 hours of birth), found 52 with enlarged thymic shadows. Negroes and large, heavy infants showed the highest percentage of enlarged thymus. At the end of six months, only six infants still showed increase in the thymic shadow, and in these the symptoms associated with an enlarged gland were absent. There is no question, therefore, but that quite a few of the cases with a residual or hyperplastic thymus undergo spontaneous involution.

The author's study of infants under one year, who were radiographed for various reasons, revealed a residual or hyperplastic thymus in less than 5 per cent of those examined. It occurred with equal frequency in both sexes.

Kirkland's (4) classification according to age groups is very convenient:

1. Hyperplastic thymus producing symptoms in the first few hours of life.
2. Hyperplasia of the thymus causing symptoms in the first few weeks of life, such as crowing, cyanosis, and difficulty in nursing.
3. Hyperplastic thymus found at a later age, which may, or may not, be symptomless.

SYMPTOMATOLOGY

The effects of the hyperplastic gland cannot be explained entirely by the physical encroachment; the paroxysmal and prodromal reactions point to some other unknown inherent action. Furthermore, investigation of thymic deaths did not give the indication that pressure by the thymus actually caused death (5). The clinical manifestations of a moderately enlarged gland may induce severer symptoms than those observed with greater hyperplasias. In the author's series two infants with slight unilateral thymic hypertrophy revealed almost persistent objective signs of mediastinal embarrassment until relieved by radiation therapy.

The pressure effects in the small space of the upper mediastinum can be conceived in view of the fact that the ventrodorsal dimension measures about 22 mm. from sternum to vertebral column. In this limited space, the trachea, esophagus, great vessels, lymphatics, and nerves are also located. Recurrent laryngeal paralysis is the most serious complication.

DIAGNOSIS

Hyperplasia of the thymus is essentially an infant's disease. The characteristic diagnostic symptoms, which are cough, stridor, wheezing, and cyanosis, are well known to clinicians. In severe cases, bulging of the anterior pectoral wall may be seen.

The actual demonstration of an enlarged

thymus, however, is made by roentgen examination. The radiograph reveals a bilateral, dense, radiopaque shadow on either side of the upper mediastinum which fuses below with the cardiac silhouette. The genital cardiac enlargement should not add much confusion in differential diagnosis.

Uniform technic is necessary and exposures should be made with the patient recumbent and during full inspiration. Lat-

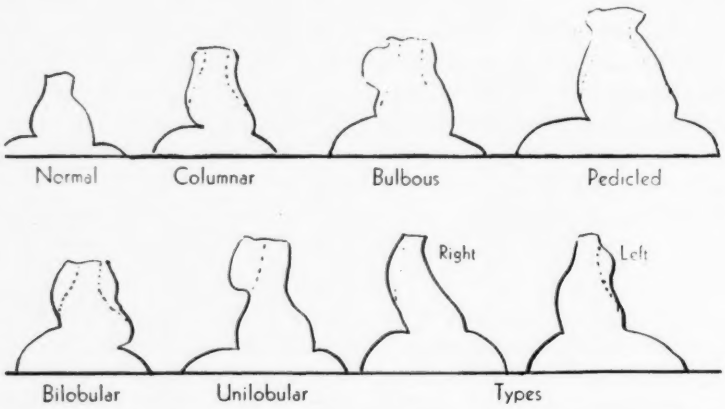

Fig. 1. Classification of types of thymic hyperplasias according to the radiographic silhouettes produced.

outer border, which is convex, may often be seen to extend beyond the heart outline. Fluoroscopically, this mass is not seen to pulsate, but the aorta and cardiac impulses may be transmitted. In rare cases, only one lobe, usually the right, appears to be enlarged. The normal transverse diameter of the median shadow, which is produced by the superimposed silhouettes of the sternum and thoracic spine, measures about 3.5 cm. in children under three years of age. The measurements may be increased to as much as from 10 to 20 cm. in thymic hyperplasia. According to Frank (6), when the lateral enlargements are one and a half to twice the width of the bodies of the third or fourth dorsal, the thymus is considered enlarged.

Normally, the cardiovascular or mediastinal angle (Gibson's notch) forms an obtuse angle or curve and is readily recognized on the film. Its obscuration on the left side may be due to an enlarged conus pulmonalis as in congenital pulmonary stenosis. Con-

eral projections of the thorax on the left side are also helpful to demonstrate abnormal narrowing of the trachea.

The roentgen diagnosis of thymic hyperplasia is not without its pitfalls. Differential diagnosis in the very young must be rarely considered, since 95 per cent of mediastinal embarrassments at this early age are of thymic origin.

Other conditions which closely or remotely resemble an enlarged thymus radiographically are: hygroma, thymoma, lymphosarcoma, Hodgkin's disease, enlarged thyroid, and mediastinal adenopathy due to tuberculosis, or that following acute infectious diseases. The anamnesis, clinical manifestations, and variance in the roentgen findings are usually helpful in differentiating the lesions.

Hygroma is seen as a unilateral, dense, sharply circumscribed mass; thymoma, which is rare in early childhood, usually involves both lobes, appearing as a dense area

almost obscuring the entire upper pulmonary fields. Lymphosarcoma and lymphogranulomatosis are usually seen in older children; the shadow produced is irregular and nearer to the hila of the lungs. A submerged thyroid is broad above and narrow below. It is unilateral and occurs almost invariably in adolescents and adults. The trachea is deviated. Tuberculous mediastinal glands are denser and wider at the roots of the lungs and may show multilobulations. Simple mediastinal adenopathy is revealed more often in older children, as a slight widening of the superior mediastinal shadow.

The radiosensitiveness of benign thymic hyperplasia is pathognomonic. Hygroma does not respond to radiation, and thymoma only feebly so. Lymphosarcoma and lymphogranulomatosis recede promptly with irradiation. A submerged thyroid must be surgically removed. Enlarged mediastinal nodes from other causes are amenable to radiation therapy.

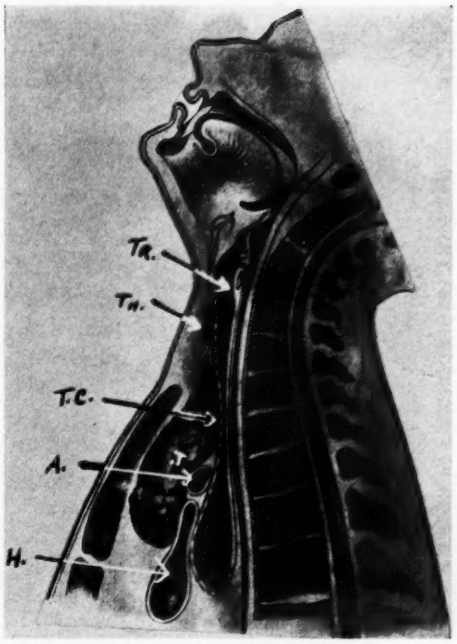

Fig. 2. Sagittal view of the thorax showing compression of the trachea by an enlarged thymus. (A. Crotti, *Journal of the American Medical Association*, Feb. 22, 1913.)

TREATMENT

In many children with hyperplastic thymus, involution occurs spontaneously. There is, however, a type in which the offending thymus produces alarming clinical manifestations, hence therapy becomes imperative. The method of choice is the application of some form of radiation. The effect is frequently observed within a week after the administration of a fractional therapeutic x-ray exposure.

The form of x-ray technic varies considerably among therapists. Kilovoltages of 90, 125, and 150 have been suggested and used, with favorable results. However, the author's choice is one in which the tube is energized with 180 kilovolts, a current of 4 ma., 40 cm. distance, for 10 minutes. This dose consists of about 100 r units. The higher voltages are preferred because of the better filtration, proper depth dose, and the more homogeneous ray procured. The immobilization of the obstreperous patient for this lengthy exposure can be successfully

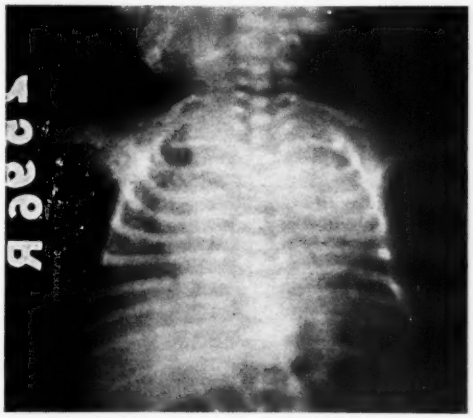

Fig. 3. Female, 10 days old, with malformed head and chest, showing a hyperplastic thymus, enlarged heart, and atelectasis of the left lung.

made with the sandbag weights on either end of a linen strip. The exposure is given once weekly for four weeks. At the end of that time, or in the interim, radiographs are made that one may observe the changes in the size of the thymus. As a rule the regression is seen after the second treatment.

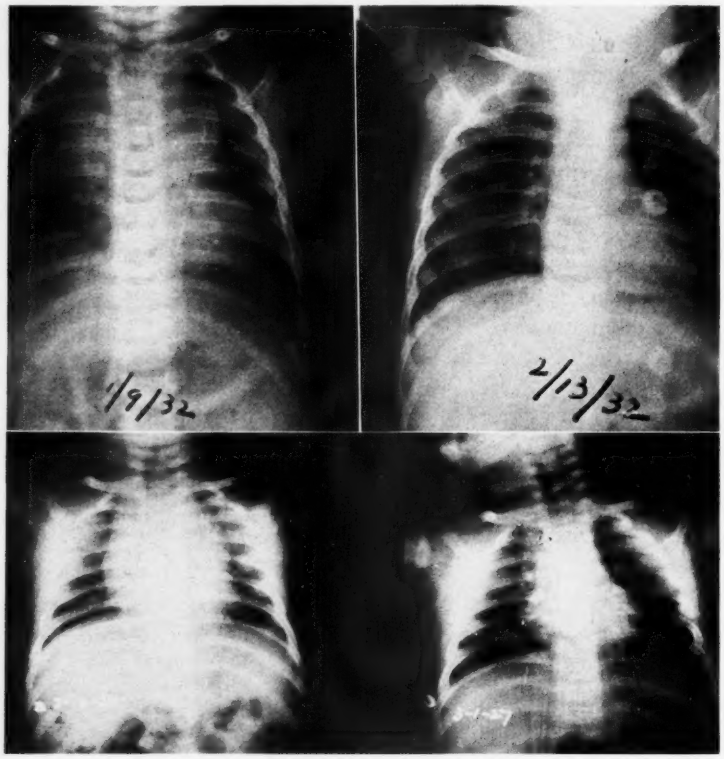

Fig. 4 *(above)*. Male, age 4 months, showing superior mediastinal area before and after irradiation. Complete involution occurred after four fractional x-ray exposures.

Fig. 5 *(below)*. Male, age 5 weeks, showing thymus before and after irradiation. The patient was brought back, with recurrence, three months after roentgentherapy.

Occasionally hyperplasia may occur some weeks or months after the apparent involution. This condition occurred in only two of the 50 cases in the author's series. In these the recurrence may be attributed to insufficient amount of treatment given. The patients discontinued treatment of their own volition. Morgan (7) reported a recurrence of 20 per cent, which seems to be unwarrantedly high; one would venture to state that these patients have received insufficient radiation. In one other of the author's cases, the almost complete involution of the thymus took place after two x-ray exposures and the hyperplasia recurred. Complete and permanent regression followed after further x-ray therapy.

Radium as a therapeutic agent has been employed by the administration of small doses of about 200 mg.-hours. An applicator of about 100 mg. element filtered by 0.3 mm. silver, 0.5 inch distance, is used and the exposure made through four portals of

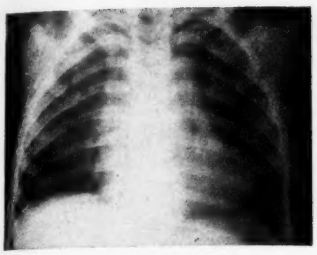

Fig. 6. Male, age 4 years, showing a residual thymus of columnar type, the usual type in infants after the first year.

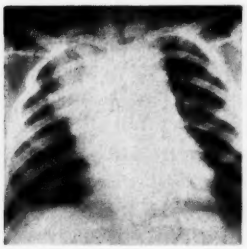

Fig. 7. Male, age 9 years, showing mediastinal widening with Hodgkin's disease. Patient recumbent.

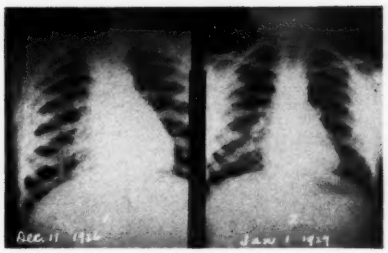

Fig. 8. Female, age 7 years, with simple adenopathy following an acute febrile disease. There was complete involution of the enlarged nodes after a series of fractional irradiation.

two hours each within a period of four weeks.

According to Bloom (8) marked reactions have been noted in cases treated with radium, although more rapid involution is usually produced. Such a reaction is not actually desirable in view of alarming symptoms that may be precipitated. The use of x-ray therapy alone has met with almost universal approval and the results obtained have been entirely satisfactory.

RÉSUMÉ

1. Several unusual cases out of the 50 studied are discussed in this paper.

2. Animal experimentation suggests the presence of an internal secretory function of the thymus gland.

3. High voltage technic in treating benign thymic hyperplasia is the preferable method.

4. Radium therapy, while efficacious, adds a possible hazard, whereas x-rays in any form are practically innocuous.

5. Spontaneous involution may occur.

6. In probably all cases, recurrence seems to be the result of insufficient treatment.

REFERENCES

(1) Miyagawa, Y., and Wada, K.: The Influence of the Constituents of the Thymus Gland Cells on the Growth of Young Organisms. Soc. Rep. Govt. Inst. Infect. Dis. Tokio, 1924, III, 42.

(2) Perkins, C. W.: Roentgen Studies and Treatment of Enlarged Thymus in Children. Med. Jour. and Rec. (supp.), April 15, 1925, CXXI, 487-490.

(3) Raue, C. S., and Fischer, C. C.: Thymus Gland in Infancy. Jour. Am. Inst. Homeop., June, 1931, XXIV, 545-552.

(4) Kirkland, A. S.: The Thymus. Canadian Med. Assn. Jour., November, 1930, XXIII, 661-665.

(5) *Editorial:* Thymic Symptoms. Jour. Am. Med. Assn., Aug. 13, 1927, LXXXIX, 526.

(6) Frank, J. W.: Roentgen Studies of the Thymus Gland in Children; Diagnosis and Treatment. Jour. Am. Inst. Homeop., June, 1931, XXIV, 553.

(7) Morgan, E. A., Rolph, A. H., and Brown, A.: Clinical Manifestations of an Enlarged Thymus. Jour. Am. Med. Assn., March 5, 1927, LXXXVIII, 703.

(8) Bloom, C. J.: Intensive Study of the Thymus. Southern Med. Jour., November, 1928, XXI, 905-911.

DIAGNOSTIC PROBLEMS IN CONSIDERATION OF SURGICAL LESIONS OF THE KIDNEY[1]

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LESIONS of the kidney present many pitfalls in diagnosis for clinical signs and symptoms are rarely pathognomonic. The interpretation of the initial symptoms is frequently misleading. Nausea, vomiting, malaise, indefinite abdominal pain, loss of weight or strength, nocturia, frequency of urination, hematuria, and fever are some of the presenting symptoms. Abdominal palpation, to locate masses or elicit tenderness, is notoriously confusing at times. We have noted a predominance of renal symptoms and signs in several extra-renal conditions. The cases presented represent mistakes in diagnosis, even after complete study. They illustrate only a few of the pitfalls for the unwary.

GASTRO-INTESTINAL SYMPTOMS

The gastro-intestinal symptoms, such as nausea and vomiting, are often late manifestations of renal disease that has given few, if any, symptoms referable to the genito-urinary tract. Conditions in the stomach, gall bladder, intestines, appendix, pelvis, and spleen may cause referred pain and symptoms that simulate renal disease. Nocturia and vomiting (1) have been reported in 40 per cent of a series of malignant disease of the kidney. The following case is illustrative of the predominance of gastro-intestinal symptoms in carcinoma of the kidney.

Case 1. C. D., male, age 62 years. The patient complained of nausea, vomiting, and progressive weakness for the year preceding examination. Roentgen examination of the gastro-intestinal tract was negative. There was an indefinite, irregular homogeneous mass in the region of the right kidney. The pyelograms showed a constant deformity, with compression and irregularity of the pelvis, and loss of normal outline of the calices.

Autopsy.—The gross specimen was a large tumor mass involving the right kidney. On section, little normal kidney tissue was found. The pelvic mucosa was free from any involvement. The renal vein was greatly dilated and invaded by the tumor mass. Microscopic examination showed areas of sclerosis, with obliteration of the major portion of the renal tissue. There were areas of proliferation and hemorrhagic changes typical of a primary carcinoma.

The clinical manifestations in primary carcinoma of the kidney depend on the location, size, rate of growth of the tumor, and whether or not the pelvis is invaded. Metastasis usually occurs through the lymphatics. Dissemination through the blood stream is rare. There is a tendency to invade the surrounding structures, which makes operative removal difficult. Most cases show local recurrence. In advanced cases, the tumor may grow into the pelvis; if so, it is difficult to determine the primary site of the lesion.

PAIN

Pain is probably the most frequent presenting symptom. Behan (2) estimates that 90 per cent of all disease begins with, or has, pain as a prominent symptom at some time during its course. Kretschmer (3) has noted pain in varying degrees and sites in 625 out of 933 cases of renal and ureteral disease. The pain of renal tumors presents no definite characteristics—cases have

[1]Read before the Radiological Society of North America, at the Seventeenth Annual Meeting, at St. Louis, Nov. 30–Dec. 4, 1931.

been reported with complete absence of pain. Movable kidney, ureteral lesions, extra-renal or extra-ureteral compressions, and gastro-intestinal and pelvic lesions may produce symptoms simulating renal pain. Infected lesions of the kidney are prone to cause considerable pain that is often not typical.

The following case report is of a patient with severe abdominal pain. The physical and laboratory findings did not point to kidney disease, yet on laparotomy a closed hydronephrotic pelvis, in the presence of a double ureter and pelvis, was found.

Case 2. W. A., male, age 45 years. The chief complaint was non-radiating pain in the small of the back for five years and constant pain for six months. The patient was quite weak, but there was no weight loss or kidney tenderness. The roentgen examination showed the right kidney to be normal in size, shape, and position. The left kidney outline was not seen. Pyelograms showed a normal right kidney pelvis and ureter. The left ureter took a tortuous course upward and outward. There was a displacement of the pelvis and calices at least eight inches from the median line.

Laboratory Findings.—There was no pus from either kidney. Phenolsulphonephthalein tests, 50 per cent (in two hours); non-protein nitrogen, 30; hemoglobin, 70 per cent; white blood count, 8,000.

Operation.—Exploratory laparotomy, left nephrectomy. The specimen consisted of an enormously enlarged kidney. There was a double ureter and pelvis, the upper ureter being closed off with a hydronephrotic kidney.

Diagnosis.—Hydronephrosis and hydroureter.

Anomalies of the kidney may be classified as anomalies of number, position, and form. The occurrence of duplication of the pelvis and ureter is of statistical interest only, but the fact remains that surgical complications are encountered more frequently in the presence of anomalies. Duplication of the kidney pelvis and ureter occurs in from 1 to 4 per cent of all individuals (4). The most common anomaly encountered is the unilateral division of the ureter into a Y in the upper third. The most frequent pathologic conditions found are hydronephrosis and pyonephritis.

HEMATURIA

Blood in the urine is a frequent symptom in lesions of the kidney and should call for exhaustive study of the genito-urinary tract. The bleeding is often intermittent. Unless it is associated with considerable pain, the hematuria may be minimized and the patient lured into a false sense of security, until later he returns with an advanced renal disease. Hematuria may be due to intrinsic and extrinsic lesions of the genito-urinary tract (5), systemic causes, and essential hematuria. Allergic response of the kidney has been suggested in some cases of hematuria associated with localized retinal edema (6). It has been noted after violent exercise, with cold as an added factor (7). Hematuria may result from trauma, vascular congestion, or from the ulcerative destruction of normal vessels or those found in association with the development of tumors (8).

Chute (9) reports that, in 100 cases of proven hematuria, 44 per cent were due to malignancy of the genito-urinary tract. In 933 cases, Kretschmer (3) noted that 39 per cent were due to lesions of the kidney. With the exception of calculi, disease of the ureter is a relatively uncommon cause of hematuria. Recently, papillitis has been recognized as a cause of renal bleeding (10).

The most common causes of renal hematuria are tuberculosis, calculi, infection, and tumors (3). The presence of calculi, or the ordinary pyogenic infection, does not rule out tuberculosis or tumor, as many instances of double lesions of the kidney, notably calculi and tumor, have been reported (3). Hematuria may occur in acute fevers, nephritis, cardiovascular disease, purpuras, and

after the administration of various drugs. Varicosities and angioma (11) of the pelvis may be responsible. The French and German writers have referred to a disturbed renal vasomotor system, angioneurosis and neuropathies as sources of origin of hematuria.

In the following case hematuria was the outstanding symptom. The recent thyrotoxicosis overshadowed the renal complaints.

Case 3. L. G., female, age 63 years. The chief complaint was blood in the urine, which had been present for three weeks, with some frequency and terminal dysuria at the onset of the symptoms. She had noted blood in the urine two years previous to the present examination. Thyroidectomy had been performed two months before the woman presented herself to us. The patient was quite weak. The right kidney was tender to percussion. Roentgen examination showed an irregularity of the upper pole of the right kidney. Pyelograms showed a lack of filling of the right middle major calyx. Intravenous pyelograms revealed delayed function of the right kidney.

Laboratory Findings.—Numerous white and red blood cells in the urine. Hemoglobin, 50 per cent; white blood count, 8,900.

Operation.—Right nephrectomy.

The gross specimen consisted of a normal sized kidney with a tumor mass, 7 cm. in diameter, on the convex surface, of a yellowish brown color with numerous red hemorrhagic areas.

Microscopic examination showed that the tumor was composed of large bulky areas with no attempt at formation of tubules or glands.

Diagnosis.—Hypernephroma.

The symptoms of hypernephroma are not characteristic: hematuria, pain, and tumor are the classical ones. Kretschmer (1) noted this triad in only 18 per cent of cases. Cachexia and fever are usually late symptoms. Not infrequently, evidences of metastasis are discovered before the kidney is suspected. The tumor is formed of varying sized nodules of soft, yellow tissue with many hemorrhagic areas. Grawitz considered that these arose from metaplasia of small, misplaced islands of adrenal tissue. There is a remarkable tendency to invade the renal vein. Extensions to the other kidney, or as far as the heart, are not infrequent. The cells of the tumor are large, clear, columnar, or cylindrical with a delicate stroma, having a network of fine blood vessels.

The roentgenogram may show symmetrical enlargement of the kidney shadow or some local projection. There may be areas of increased density, and, if the tumor is large, part or complete loss of the kidney shadow. The pyelographic signs, which are usually diagnostic, consist of elongation, flattening, narrowing, and even obliteration of one or more of the calices.

TUMOR

A palpable mass in the kidney region usually presents a problem in diagnosis. An enlarged spleen, a Riedel's lobe of the liver, retroperitoneal cysts, and tumors in the region of the kidneys may simulate kidney masses. A gastro-intestinal examination is a necessity. A shadow on the roentgenogram, apart from that of the kidney, would be conclusive. Any displacement of the ureter is suggestive of renal tumor, although extrinsic lesions, retroperitoneal growths, cysts, and hydronephrosis may cause displacement. An extra-renal tumor may deform the pelvis by pressure, while a tumor in the pelvis may not change the contour or outline until it is large enough to produce obstruction. Certain anomalies, congenital cysts (12), and polycystic kidney may present irregularities suggestive of tumor.

The findings in the following case were deceptive. This patient presented a mass in the kidney region and frequency of urination.

Case 4. H. R., male, age 50 years. The

chief complaint was a slowly growing, painless mass of three months' duration in the upper right quadrant, associated with loss of 50 pounds in weight and frequency of urination. There was a hard, non-tender mass in the right abdomen, reaching from the costal margin to the midline and well below the umbilicus.

Roentgen examination showed a large dense homogeneous mass involving the right side. The kidney was seen above and to the medial side of the mass. Pyelograms showed a marked displacement and irregularity of the right kidney pelvis, with a displacement of the right ureter toward the median line.

Operation.—A large mass obscuring the right kidney was removed *in toto*. It proved to be a lobulated tumor mass, reddish yellow in color, $11 \times 20 \times 26$ centimeters in size.

Microscopic examination showed a loosely arranged tumor composed of neurogenic cells with ganglionic cells and neurons. There were smaller stellate cells with one or more polar processes.

Diagnosis.—Ganglionic neuroma.

Many tumors containing ganglion cells have been described as arising from all parts of the body, but most often from the retroperitoneal, pelvic, or retrocervical regions, in which they might have arisen in connection with the sympathetic system. The ganglion cells are usually imperfectly developed and irregular in form. There is no proper connection with any nerve ending. They are usually benign tumors, but a few have shown extensive metastases which seem to have developed from the smaller and less differentiated cells.

FEVER

The symptom of fever is fairly constant in infectious lesions of the kidney. It also occurs in about 20 per cent of hypernephromas (1). The following case presented clinical and radiographic evidence of a renal lesion, yet the symptoms were shown to be due to an extra-renal disease of an unusual variety.

Case 5. D. C., female, aged 61. The chief complaint was severe pain in the left flank radiating downward. Blood had been present in the urine for the week preceding the present examination, and afternoon chills had been experienced for a month. The patient was undernourished. There was a mass in the left abdomen almost to the midline and extending three fingers below the umbilicus. Roentgen examination showed a stone in the left kidney pelvis with a large indefinite mass in the left side surrounding the kidney. There was no line of demarcation between this mass and the spleen. Pyelograms showed a dilated, distorted left kidney pelvis.

Laboratory Findings.—The urine contained many red blood cells. Hemoglobin, 51 per cent; red blood count, 2,130,000; white blood count, 9,600; polymorphonuclears, 84 per cent; phenolsulphonephthalein test, 45 per cent.

Operation.—Left pyelolithotomy.

The patient became steadily worse, running a high septic fever. An exploratory operation was done 13 days after the original operation, because of the continued fever and the left-sided mass. There was a large spleen, which was considered not removable. At autopsy, general peritonitis and a very large spleen were observed. Microscopic examination showed only an occasional malpighian body. There was very little normal pulp found. Large areas were involved in tubercle formation, with extensive necrosis and caseation surrounded by numerous giant cells.

Diagnosis.—Tuberculosis of the spleen, liver, and mesenteric nodes.

In any dissemination of tubercle bacilli through the blood stream, the spleen (13) is certain to be involved. Rokitansky has pointed out that, at postmortem, tuberculosis is found to have affected the spleen only less

frequently than it affects the lungs and lymph nodes. Primary tuberculosis of the spleen is rather rare. Winternitz has collected 51 cases from the literature. The symptoms reported are not characteristic. There are nausea and vomiting, backache, fever, and night sweats. The white blood count is usually not affected. Polycythemia was noted frequently. Tuberculosis of the liver and lymph nodes is usually associated.

CONCLUSIONS

Lesions of the kidney present a problem in diagnosis. Clinical signs are often misleading. The gastro-intestinal symptomatology is usually a late manifestation of advanced renal disease.

Pain is probably the most frequent presenting symptom. We have been impressed with the seriousness of hematuria as a symptom and the desultory nature of the usual investigation directed toward its solution.

Another chapter might be written on the gastro-intestinal deformities produced by extra-alimentary lesions, of which those caused by the kidney are numerous.

Some of the pitfalls in consideration of surgical diseases of the kidney have been pointed out with illustrative case reports. Even after exhaustive examination, the nature of the suspected renal lesion may be obscure, with the true nature revealed only at operation or postmortem.

BIBLIOGRAPHY

(1) KRETSCHMER, H. L.: Early Diagnosis of Malignant Disease of the Kidney. Southern Med. Jour., February, 1925, XVIII, 92-99.
(2) BEHAN, R. J.: Pain. D. Appleton and Company, New York, 1914, p. 1.
(3) KRETSCHMER, H. L.: Hematuria; a Clinical Study Based on 933 Consecutive Cases. Surg., Gynec. and Obst., May, 1925, XL, 683-686.
(4) CROWELL, A. J., THOMPSON, R., SQUIRES, C. B., and PALMER, B. M.: Pathological Conditions Arising in Duplication of the Kidney Pelvis and Ureter; Report of 12 Cases. Southern Med. Jour., September, 1931, XXIV, 741-749.
(5) EISENDRATH, D. N.: Hematuria, Its Interpretation. Jour. Am. Med. Assn., LXXXVI, 825.
(6) COCA, A. F.: Specific Sensitiveness as Cause of Symptoms in Disease; Essential Hematuria and Localized Retinal Edema as Possibly Allergic Symptoms. Bull. New York Acad. Med., September, 1930, VI, 593-604.
(7) STEVENS, A. R.: Hematurias of Obscure Origin. Jour. Am. Med. Assn., Oct. 14, 1922, LXXIX, 1302-1305.
(8) HERMAN, L.: Renal Hematuria. Jour. Am. Med. Assn., Oct. 25, 1924, LXXXIII, 1315-1321.
(9) CHUTE, A. L.: Importance of Hematuria as a Symptom. Jour. Am. Med. Assn., Oct. 25, 1924, LXXXIII, 1321-1323.
(10) KEYES, E. L.: Urology. D. Appleton and Company, New York, 1928, p. 352.
(11) HYMAN, A.: Renal Hematuria. Am. Jour. Surg., December, 1920, XXXIV, 312.
(12) BRAASCH, W. F., and CARMAN, R. D.: Pyelographic and Roentgenologic Diagnosis of Renal Tumors. RADIOLOGY, June, 1925, IV, 445-452.
(13) BUNTING, C. H.: in Tice, Practice of Medicine, VIII, 290.

DISCUSSION

DR. B. H. NICHOLS (Cleveland, Ohio): I feel that we sometimes do not pay quite enough attention to kidney problems, yet there is probably nothing more important in medicine than the early recognition and correct diagnosis of kidney lesions.

I should like to emphasize the first symptom which Dr. Lockwood mentioned, that is, pain. I think we are oftentimes apt to feel, when we find blood or pus in the urine, that there are kidney lesions. But there are many kidney lesions in which these symptoms are not present, particularly hydronephrosis due to aberrant blood vessels. Unless the patients have had retention for a long time and there is secondary infection, there will be no findings whatever from the urine examination.

Another important lesion to remember is suspected stones. For instance, we make a roentgenographic examination of the urinary tract in the case of a patient who has pain and symptoms of urinary calculus, but the film is negative. The urine examination gives negative results. If there is any evidence at all of suspected kidney involvement, a pyelogram of the kidney should be made, because many times it will reveal a stone that would not be shown by any other means.

In a large series of cases of hypernephroma of the kidney, I think only about 50 per cent of them showed blood in the urine. Of

course, we have no trouble in our cases that show definite urinary symptoms. It is in those cases in which nothing is found in the urine to give us a key to the kidney condition that we are apt most often to miss a pathologic kidney.

DR. LOCKWOOD (closing): There is nothing further to add except to lay stress again, as Dr. Nichols did, on pain as the most frequent presenting symptom. Also gastro-intestinal symptomatology is a frequent presenting symptom in genito-urinary lesions.

CASE REPORTS

THE SIGNIFICANCE OF A SHADOW IN THE RIGHT CARDIOHEPATIC ANGLE[1]

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The observation that a triangular honeycombed shadow of increased density, lying in the angle made by the right heart border and the dome of the right diaphragm, is due to an atelectatic bronchiectatic lobe of the lung is not original. However, this finding is frequent enough to warrant calling attention to it again by the publication of the following case reports:

Case 1. R. M., white, male, age 34 years, was sent to the hospital with a diagnosis of pneumonia and accompanying pulmonary hemorrhage, cough, and foul sputum.

Past History.—Up to the age of 21 years, the patient's history is unimportant. At that time (1918), while serving in the army, he contracted bronchopneumonia and was confined to bed for ten weeks, following which he was discharged from the army with a diagnosis of asthma as a complication of his pneumonia. The patient has never had a typical attack of asthma, but he did have a productive cough which has remained more or less constantly with him. He had no shortness of breath, but found it necessary to sleep with his head propped up.

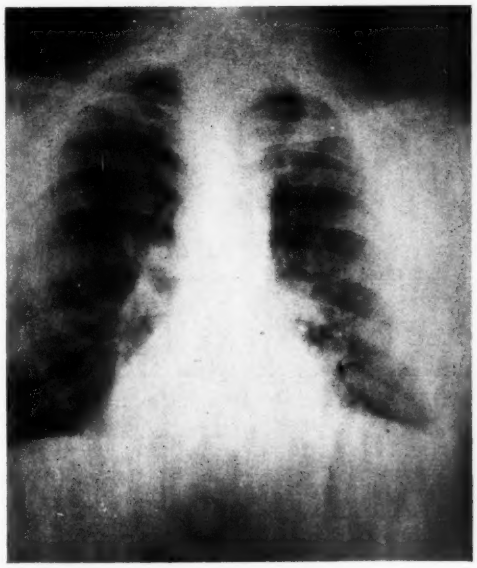


Fig. 1. Case 1. Arrows point to the shadow in the right cardiohepatic angle.

While the sputum brought up was greenish and shiny, it did not have a foul odor.

The patient had a second attack of pneumonia at 26 years of age, returning to work within seven weeks without any change in his cough or sputum, and a third attack at the age of 31 years, again returning to work within seven weeks. After this attack, he noticed some shortness of breath and that the cough became worse, but he continued to do heavy work (machinist) until his

[1]Received for publication in May, 1932.

fourth attack of pneumonia, which began six weeks before admission to the hospital.

Present Illness.—This latest illness was preceded by one week of malaise. The man felt feverish and noticed that his sputum had much more comfortable when he was lying on his right side.

Six days previous to his admission, the patient felt something break in his chest beneath the lower part of his sternum, and

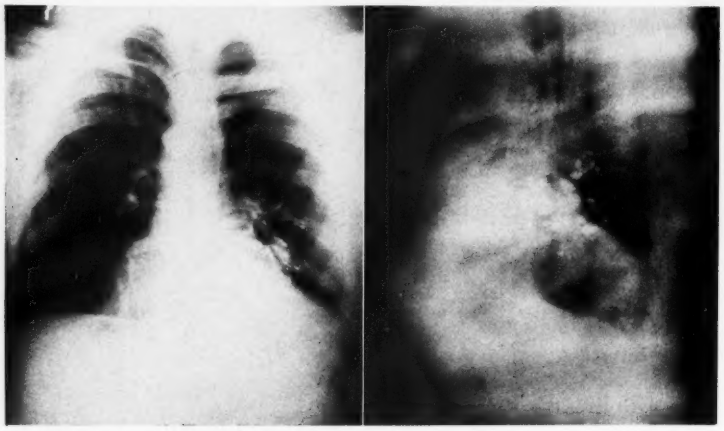
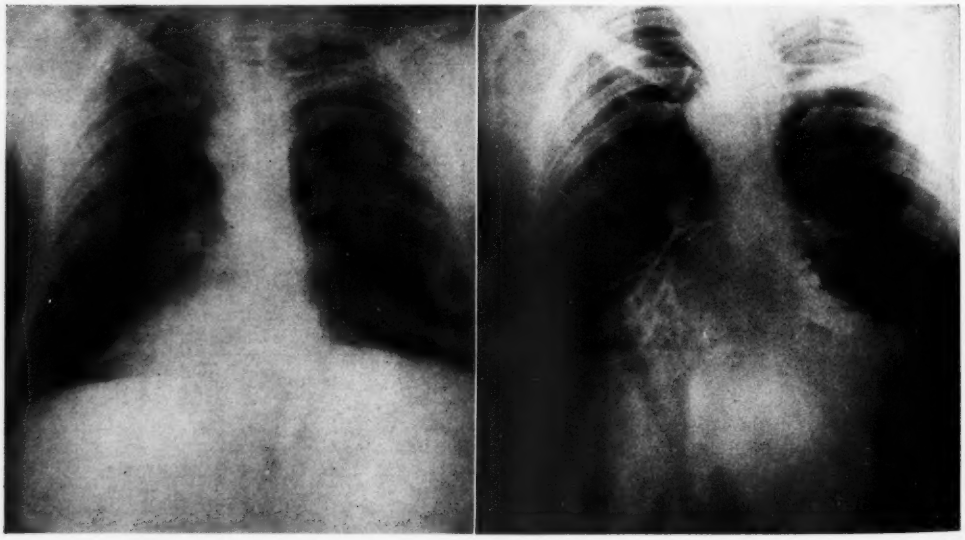


Fig. 2 *(left)*. Case 1. Lipiodol is seen in the dilated bronchi in this area.
Fig. 3 *(right)*. Case 1. A lateral view of the same area.

a foul odor for the first time, and his dyspnea increased. He spent four weeks in bed, but the cough, foul sputum, and dyspnea continued. He discovered that he was tarry blood gushed from his mouth, following a fit of coughing. His temperature, which had never been over 101°, was not constant. He had been afebrile for three



Figs. 4 and 5. Case 2. Films of chest before and after lipiodol, showing the same condition as presented by Case 1.

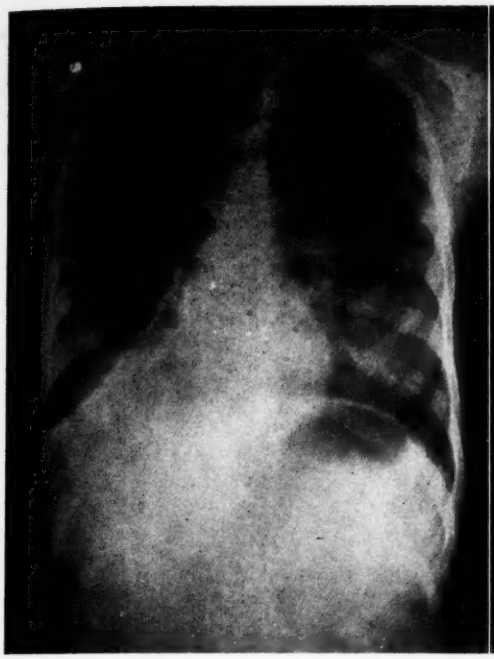


Fig. 6. Shows the chest before lipiodol, with the honeycombed density in the right cardio-hepatic angle.

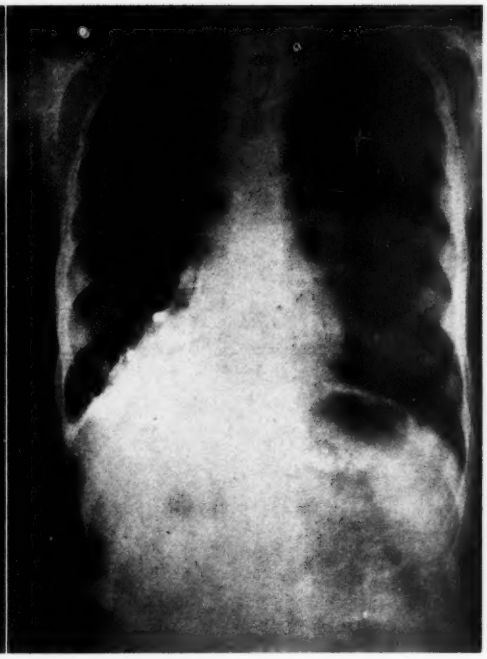


Fig. 7. Made after injection of lipiodol into this area, shows it to be a bronchiectatic atelectatic lobe.

weeks preceding his admission. His temperature was 100°, and pulse 100.

Physical Examination.—The patient was a well nourished, well developed white male, lying propped up in bed, and having some respiratory difficulty. His face and lips were a slate blue color, but he did not appear to be acutely ill. The examination was negative, except for the chest. On auscultation, many râles of all varieties were heard over the right base, anteriorly and posteriorly, diminishing toward the apex. The right base was flat from the angle of the scapula down. An x-ray examination (Fig. 1) showed a dense, honeycombed triangular shadow occupying the space between the right heart border and the dome of the right diaphragm. An injection of lipiodol into the right lower bronchus (Figs. 2 and 3) revealed this shadow to be due to an atelectatic lobe with many large, dilated bronchi.

Six sputum examinations were negative for the tubercle bacillus. Several organisms were found, streptococci and the fusiform bacilli predominating.

Postural drainage was instituted and 450 c.c. of sputum were obtained the first day. The amount rapidly decreased to between 15 and 30 c.c. per day and has remained at that level for many months. The patient's temperature dropped to normal. Since his discharge from the hospital he has been able to resume his occupation. He has had very little shortness of breath and the physical findings at the right base have improved considerably.

This case is reported in detail because it offers an interesting field for speculation as

to the cause of the repeated attacks of pneumonia. Have they been simply exacerbations of the chronic inflammatory process which exists in the region of the bronchiectasis?

Case 2. P. C., white, male, age 44 years, was admitted to the Out-patient Department on Nov. 25, 1931. He had complained of pain in the left eye and headache since Nov. 2, 1931. He was referred to the Eye Clinic for immediate attention, where a diagnosis of corneal ulcer was made. This cleared rapidly under appropriate treatment and the patient was then referred to the General Medical Clinic for general examination. He gave a history of a long-standing productive cough which had improved somewhat following a tonsillectomy four years before the present examination. Auscultation of the chest showed some impaired resonance and coarse râles at the right base posteriorly.

An x-ray examination of the chest (Figs. 4 and 5), before and after lipiodol, showed a condition similar to that of Case 1.

Case 3. J. C. was seen in the Out-patient Department in December, 1927, at the age of 13 years. She had complained of a chronic cough and purulent expectoration since tonsillectomy seven years previously. The cough and expectoration had become worse during the past six months and she had lost weight.

Examination of the chest showed dullness at the right posterior base, up to the angle of the scapula, with harsh bronchial breathing and many coarse râles.

A CASE OF INTUSSUSCEPTION OF THE COLON ASSOCIATED WITH GENERAL INTESTINAL LYMPHOSARCOMATOSIS

By ASA B. FRIEDMANN, M.D., and ANTHONY F. SAVA, M.D., Brooklyn, N. Y.

Lymphosarcoma involving the large and small bowel has been reported. Intussusception of the large bowel in an adult has also been repeatedly reported but a search of the recent literature does not reveal any cases in which the combined diagnosis was made pre-operatively on roentgenographic study. It is seldom that the opportunity is given to the radiologist to make a pre-operative diagnosis of intussusception of the large bowel and to further study a case so that a definite opinion as to etiology may be reached. The following case is therefore reported:

R. H., white male, aged 40, was referred for gastro-intestinal x-ray study because of indefinite generalized abdominal cramps and diarrhea. Until three months prior to his present illness, he was entirely well. His

Fig. 1. Oblique view of stomach showing polypoid masses within the first portion of the duodenum.

cramps, beginning about that time, came only occasionally and were neither characteristic enough in their radiation nor in their relation to food intake or bowel evacuation to suggest any clinical entity. Within the next couple of months, the pains increased in severity and duration, eventually

Fig. 2. Six-hour study showing nodular infiltration along the wall of the ileac loops.

becoming almost constant. A few months before his examination, he began to experience diarrhea and on four occasions had macroscopic blood in his bowel contents. Neither diet nor medication brought any relief and he lost about fifteen pounds within a few months. There was no temperature reaction, no skin eruption, nor any other findings that would suggest an infectious disease.

The past history and family history are essentially irrelevant. Physical examination showed a well nourished, well preserved, white, adult male of 40, with nothing of special interest except within the abdomen.

Fig. 3. Barium enema study showing cecal mass through which distended mucosal bands can be seen; also pronounced colitis in descending colon.

The peripheral glandular system was examined, no palpable adenopathy being discovered. The abdomen was somewhat tender throughout. No masses were palpated nor could the presence of peritoneal fluid be determined. Fluoroscopy of the heart and lungs was essentially negative. There was definitely no evidence of pulmonary tuberculosis. The esophagus was normal and the stomach was normal except for delayed opening at the pylorus. The duodenal bulb was deformed by several soft polypoid masses (Fig. 1). The small bowel showed a nodular infiltration of the terminal ileal loops. This is clearly seen in Figure 2 as filling defects along the ileac wall. At the 24-hour examination, the entire intestinal tract was empty except for a minimal residue in a distended ileac loop.

Barium enema study revealed a mass in

Fig. 4. Enema evacuation study showing mucosal structure of cecal mass.

Fig. 5. Same case. Oblique view of stomach six months later, showing pronounced increase of duodenal mass as well as nodular infiltration of pylorus and antrum.

the cecum but through this mass were seen distended bands of otherwise normal intestinal mucosa (Fig. 3). The enema emptying film proved itself of prime importance. The mucosal structure of the supposed mass was now seen to consist of concentric loops of distended mucosal markings in slightly different axes. Obviously, this could be due only to invaginated superimposed intestinal mucosa such as would be found if the markings of an intussusception were analyzed. The case was reported as one of benign polyposis of the duodenum and intussusception of the colon, secondary to a nodular, granulomatous infiltration of the ileum and cecum.

A differential diagnosis between tuberculosis and lymphosarcomatosis was suggested and laparotomy advised. The patient was hospitalized and his general condition built up by supportive measures, transfusion, etc., and he was operated on more than a week later.

At the time of operation, the duodenum was palpated and thought to be negative. It is a well-known fact that the benign duodenal infiltrations are and well can be missed by even the most competent fingers unless the lumen is opened. This was not done and, therefore, the surgeon's negative findings did not seriously disturb the x-ray interpretation. An intussusception was found, involving the cecum, while an infiltration of the terminal ten or twelve inches of the ileum was also present. There were numerous small glands palpable throughout the mesentery; a larger one of these was excised. The intussusception was relieved and ileostomy done for drainage. The patient made an uneventful recovery.

The biopsy was reported as chronic infectious adenitis, a report which was unfortunate and misleading; however, the x-ray findings were so convincing and unexplained by the pathologist's opinion, that the patient was invited for a re-examination six months

later. At this time, the duodenal mass had reached huge proportions, at least three times its previous size, the pyloric end of the stomach being seen to be similarly infiltrated (Fig. 4), while the infiltration of the ileac wall was still present. The cecum was fairly well "chewed out" by an infiltrating neoplastic process. There was an early (Fig. 5) recurrence of intussusception somewhat farther along the colon. Clinically, the patient was not doing very well and showed a huge doughy mass within the abdomen, the pressure effects of which were evident on the gastric films. A definite diagnosis of lymphosarcomatosis was now made and x-ray therapy advised.

A course of x-ray therapy was outlined, but the patient drifted from our hands and eventually was received at the Memorial Hospital in New York City. During the few months intervening he had developed peripheral adenopathy, particularly involving the supraclavicular glands. One of these glands was removed for biopsy at the Memorial Hospital and reported as lymphosarcoma.

We are grateful to the Memorial Hospital staff for their courtesy in reporting this to us and thus proving our roentgenologically made diagnosis to be correct.

Finally the patient left the Memorial Hospital and entered one of the naval hospitals where, being a veteran, he was entitled to free treatment. He died at that institution, taking the course that all lymphosarcoma cases do.

In summarizing the second x-ray study, the following points must be emphasized: there was a nodular infiltration of the gastro-intestinal tract involving the pyloric end of the stomach, the duodenum, the ileum, and the cecum. The pathology was sufficient to bring about a chronic intussusception.

Fig. 6. Same case. Enema evacuation study six months later showing "chewed-out" defect in cecum and early recurrence of intussusception in ascending colon.

SUMMARY

1. A proven case of lymphosarcomatosis involving extensively the gastro-intestinal tract is reported.

2. The diagnosis of colonic intussusception was made roentgenologically.

3. The diagnosis of intestinal lymphosarcomatosis was made roentgenologically.

EDITORIAL

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THE SOILAND NUMBER

The Editor is happy to follow the recommendation of the Publication Committee in dedicating this issue of RADIOLOGY to Dr. Albert Soiland. Throughout the history of the Journal, Dr. Soiland has been a loyal friend, contributing papers, giving the benefit of his counsel. The Editor is proud to name this issue in Dr. Soiland's honor.

ALBERT SOILAND, M.D.

AN APPRECIATION

This number of RADIOLOGY is dedicated to Dr. Albert Soiland, one of the leading active radiologists of the world.

It is because Dr. Soiland has been recognized as a national and international leader in the field of medical radiology, a noted trainer of students, himself an eminent student, and because of many other outstanding achievements which have been accomplished by his tirelessness, his unfailing friendship and loyalty, his honesty and fearlessness, his organizing ability and his pleasing but powerful peronality, that the Executive Officers of the Radiological Society of North America, the Publication Committee, and the Editor have chosen this occasion to award him just honor.

There can be no more timely tribute than to dedicate this May issue of RADIOLOGY to his honor, for in this month occurs the memorable occasion of the sixtieth anniversary of his birth. It is not intended to present in these pages a highly eulogistic recital of events in his career, but, rather, to chronicle briefly some of the more important accomplishments of his life. Homage does not permit the pages of this number to open for an article by the dedicatee, but, if it were permissible, it would still further enhance the excellence of the issue.

Dr. Albert Soiland was born in Stavanger, Norway, on May 5, 1873. He is the son of Edward and Axeline Christine (Halvorsen) Soiland. At ten years of age he came to the United States. His education, begun in the primary schools of Norway, was continued in the American public schools.

Before entering his premedical work, which was completed at the University of Illinois, he was employed by the Wagner Palace Car Company and during this work received a broad experience in business relations, largely because he was stationed in different parts of the United States. During college vacation periods he was Assistant District Superintendent at Dennison, Texas. In 1896 he was able to associate himself with Dr. W. G. Terry and Dr. Pierre Wilson as his preceptors in medicine. With these physicians, interest in electricity was developed and together they constructed a coil from which they were able to show an appreciable spark in air. In their experiments with this coil, discharging its current through a vacuum tube and using photographic plates they succeeded in obtaining their first x-ray images of opaque substances. In 1898 he assisted in assembling the first x-ray plant (static machine) in the Los Angeles County Hospital. In 1899, using a home-made coil outfit, he made what was probably the first localization of a foreign body in the California Hospital.

The day after graduating in medicine in

1900, he went to Longleaf, Louisiana, where he had secured an appointment as Surgeon to the Crowell Spencer Lumber Company. In the Summer of 1901 he returned to Los Angeles and became Assistant to Dr. H. G. Brainerd, whose influence did much to shape his career. It was during this association that Dr. Soiland established an x-ray department, probably the first regular medical office of this type in Southern California. In 1904 he established the Department of Radiology in the College of Medicine, University of Southern California, becoming at first Instructor and later Professor.

The Degree of Doctor of Medicine was received from the University of Southern California on June 14, 1900. From the very beginning of his medical career, his work was associated with or confined to medical radiology. With his associates, the Albert Soiland Radiological Clinic was established in 1910. During his medical career he has been active in research, clinical practice, and medical organization. He has contributed to every phase of radiology, but at present his energies are confined to therapeutic radiology. The latest developments in equipment and method have characterized his work, and his clinic has been a Mecca for visiting radiologists from all parts of the world. His record as a pioneer in radiology is well known and the most recent advance in the use of extremely high voltages has found him giving cautious and conscientious effort to stabilize this unusually hazardous undertaking, reinforced by his many years of clinical experience with both x-rays and radium. It has been his custom to incorporate in his practice with private patients, regardless of the expense involved, any research development which offers a probability of clinical value. Difficulties that seemed almost insurmountable confronted him in the addition of this very high voltage apparatus to his private equipment, but as soon as the research problems had been settled, the specifications were completed for the excavation, concrete wall construction with lead protection, and equipment installation. To-day he possesses one of the first extremely high voltage, short wave length, x-ray equipments.

ALBERT SOILAND, M.D.

Medical organization has received much of his time and effort. In addition to his membership in the local and state medical societies, he has been active in the American Medical Association, having been returned many times to its House of Delegates, and he has given valuable service to the Association in many other capacities. He is a Fellow of the American College of Physicians (June 19, 1917); Fellow (Honorary) of the Northern Association for Medical Radiology (Scandinavia) (June 1, 1924); Founder and present President, American College of Radiology (June 25, 1923); he holds the Diploma in Medical Radiology and Electrology, University of Cambridge, England (March 25, 1926); he is a Fellow of the American Medical Association; a Fellow of the Los Angeles Clinical and Pathological Society; Founder and past President

of the Pacific Coast Roentgen Ray Society; Founder and past Chairman of the Section on Radiology, American Medical Association; past President of the Radiological Society of North America; past President of the American Radium Society; member of the American Roentgen Ray Society; Chairman of the Malignancy Board, California Hospital; Chief Roentgenologist of the Santa Fe Coast Lines Hospital.

Aside from activities in clinical medicine and medical organization, many other interests have found place in the life of Dr. Soiland. He is a member of the California Club; of the Los Angeles Athletic Club group; of the Wilshire Country Club; of the Tuna Club; of the Uplifters Club; of the Yacht Clubs of California, Los Angeles, Newport Harbor, Catalina, Transpacific, Southern, Detroit, Santa Barbara, St. Francis, and the Royal Norwegian.

His hobby, if he can be said to have one, is yachting. His activities in this line have created a large group of friends among whom he is well known as "The Skipper." The narrative, "The Viking Goes to Sea," published in 1924, is a thrilling and exciting description of a yacht race in Honolulu. In this race the spirit of the Vikings manifested itself in Dr. Soiland, for, as her skipper, he piloted the *Viking IV* to victory.

Dr. Soiland was recognized in the January, 1933, issue of the magazine, "Yachting," by having a page dedicated in his honor. With the permission of the Editor of that magazine, we have the privilege of reproducing this page *verbatim*. The article is introduced with Dr. Soiland's portrait.

"IN THE WORLD OF YACHTING: COMMODORE ALBERT SOILAND

"This month we turn to the Pacific Coast to pay tribute to the indefatigable work on behalf of the sport of yachting by Dr. Albert Soiland, of Los Angeles. As Commodore of the Transpacific Yacht Club, Dr. Soiland biennially develops enthusiasm among Western windjammers for the 2,180-mile jaunt to Honolulu. Thrice he has participated in this classic, first in 1923 with his schooner *Viking IV*, a second time on the record-holding *Mariner* in 1926, and again in 1930, aboard *Contender*.

"Commodore Soiland's efforts in behalf of yachting on the West Coast include active participation in the work of many organizations. His first official post dates back to 1914 as organizer and as first Commodore of the Newport Harbor Yacht Club, an office which he is filling again this year. In 1915 he was elected Commodore of the venerable South Coast Yacht Club. Largely through his efforts in 1921 there was organized the Southern California Yachting Association, which he served as Commodore during its first two years. Later, he effected the organization of the Pacific Coast Yachting Association and served as its head in 1923. In addition to the local offices he has held, Commodore Soiland has served on the Executive Committee of the North American Yacht Racing Union.

"Craft flying Commodore Soiland's house flag include the historic *Vasco de Gamma*, and *Vikings I, II, III, and IV*, the latter a 54-foot auxiliary schooner. He founded the Snowbird fleet of his home club by liberally donating boats to the junior members, and he was instrumental in establishing the Six-meter Class on the Coast by helping to organize the syndicate which brought *Synnove* to his home port."

Dr. Soiland is a Mason; he is also a Scottish Rite Mason and a Shriner. Phi Rho Sigma and Theta Nu Epsilon are his fraternities.

During the World War he was Assistant Surgeon, Med. R. C., and he is now Lt. Comdr. M.C., U. S. Navy Reserve.

His contributions to medical literature are tabulated herewith, the catalogue being as nearly complete as possible, and arranged in chronological order.

"Treatment of Incised Wounds," So. Calif. Pract., 1901, XVI, 93.

"Notes on 150 Cases of Smallpox in Private Practice," Jour. Am. Med. Assn., October, 1901.

"A Case of Carcinoma of the Breast Treat-

ed by X-rays," So. Calif. Practitioner, April, 1902.

"Electricity in the Diagnosis and Treatment of Tuberculosis," So. Calif. Pract., 1902, XVII, 212-214.

"Clinical Results with Roentgen Rays," So. Calif. Pract., July, 1903.

"Radiophobia and Radiomania," Am. Electrotherapeutic Jour., October, 1903.

"Roentgen-ray Therapy and Technic," Jour. of Advanced Therapeutics, April, 1903.

"Finsen Rays," So. Calif. Pract., 1904, XIX, 47-50.

"Plea for Combining the X-rays with Surgery in Mammary Carcinoma," So. Calif. Pract., July, 1904.

"The Surgeon and the X-rays," Calif. Med. and Surg. Reporter, January, 1905.

"The Finsen Light Treatment," So. Calif. Pract., 1905.

"Electrical Apparatus and Therapy," So. Calif. Pract., 1905, XX, 445-450.

"Indications for Treatment by Electricity," So. Calif. Pract., 1905, XX, 520, 521.

"Electricity—Its Place in Modern Medicine and Surgery," President's Address, So. Calif. Electro-medical Society, December, 1905; pub. in Los Angeles Med. Jour., 1905.

"Osteosarcoma of Fibula," Archives of Physical Therapy, December, 1906.

"A Symposium of Roentgen Rays in Skin Diseases," Am. Jour. of Dermatology, April, 1907.

"X-rays in Skin Disease," Am. Jour. of Dermatology, April, 1907.

"Results of Roentgenization in Superficial Malignancies," Calif. St. Jour. Med., August, 1907.

"The Indications for Treatment by Electricity," Electrotherapist, October, 1907.

"Unrecognized Fractures of the Hip," Jour. Am. Med. Assn., May, 1908.

"Roentgenographic Findings in Fractures about the Elbow Joint," Calif. St. Jour. Med., 1909.

"The Finsen Institute in 1910," So. Calif. Pract., 1911, XXVI, 25, 26.

"Stereoscopic X-ray Photography," So. Calif. Pract., 1911, XXVI, 357-359.

"Notes on X-ray Treatment, with Special Reference to Skin Lesions," Los Angeles Co. Med. Soc., 1911.

"Roentgen Interpretation of a Few Common Type Fractures," So. Calif. Pract., 1912, XXVII, 521-525.

"Practical X-ray Work for the General Practitioner," Pacific Coast Roentgen Ray Soc., 1912.

"Hereditary Pigmented Nevus," Calif. St. Jour. of Medicine, November, 1912.

"A General Discussion of Radiation from a Therapeutic Standpoint," Arizona St. Med. Soc., 1912.

"Foreign Bodies in the Air and Food Tracts," So. Calif. Pract., 1913, XXVIII, 23, 24.

"X-ray Findings along the Gastro-intestinal Tract," Calif. St. Jour. Med., 1913.

"The X-rays in Medicine and Surgery," West Coast Magazine, May, 1914.

"X-ray Studies of Stomach and Colon," So. Calif. Pract., 1914.

"The Roentgenologist—Mechanic or Consultant?" Pacific Coast Roentgen Ray Society, San Francisco, 1914.

"The Cancer Problem in the Female Breast, with Reference to Roentgen-ray Supplemental Treatment," President's Address, Pacific Coast Roentgen Ray Society, San Francisco, 1915.

"The Lay Radiographer," Radiological Society of North America, 1915.

"Modified Serial Roentgen Exploration of Pylorus and Duodenum," American Medicine, 1915.

"Dosage in Roentgenotherapy," U. S. Naval Med. Bull., 1916.

"The X-rays in Medicine and Surgery," West Coast Magazine, 1916.

"The Military and Naval Use of the Roentgen Ray," Am. Jour. Roentgenol., November, 1917.

"The Roentgen Rays in War Time," Address before Navy Group, 1917.

"The Military Use of the X-ray," Address before Navy Group, 1917.

"Comments on Roentgenotherapy," Am. Jour. Roentgenol., January, 1917.

"Electro-physical and Chemical Properties

of Roentgen Rays and Radium," Am. Jour. Roentgenol., August, 1918.

"The Medico-legal Status of the Roentgenologist," Am. Jour. Roentgenol., 1918.

"The Evolution of Roentgen Therapy in Higher Voltages," Radiological Society of North America, 1918.

"Deep X-ray Therapy in Carcinoma of the Prostate," written with W. E. Costolow, M.D.; presented before the Pacific Coast Roentgen Ray Society, 1918.

"Radiotherapy in Carcinoma of the Lip," Los Angeles Co. Med. Soc., 1919.

"An Interesting Case," Urol. and Cutan. Rev., February, 1920.

"Economic Problems of Radium Therapy," Am. Radiological Society, New Orleans, April, 1920.

"Comparison of the Reaction of Roentgen Rays and Radium," Calif. St. Jour. Med., March, 1920.

"Further Comments on Radio-activity," Am. Jour. Roentgenol., February, 1920.

"Reactions to Radium and the Roentgen Ray," Annals of Medicine, November, 1920.

"Radium Element *versus* Emanation," Am. Jour. Roentgenol., December, 1920.

"Present Problems and Future Prospects of Deep Roentgen Therapy," Am. Jour. Roentgenol., May, 1921.

"Radiation and Thyroid Disease," Jour. of Radiol., July, 1921.

"The Therapeutic Aspect of Irradiation in Superficial Malignancy," Jour. Am. Med. Assn., Nov. 12, 1921.

"Protective Factors in Modern Highline X-ray Work," Am. Jour. Roentgenol., May, 1921.

"Superradiation and Delayed Reactions," Am. Jour. Roentgenol., August, 1921.

"Radiation in the Treatment of Leukemia," Jour. of Radiol., December, 1921.

"Present Status of Radium Therapy in the Female Pelvis," Jour. of Radiol., January, 1921.

"The Rationale of Radiation in the Female Pelvis," Calif. St. Jour. Med., May, 1921.

"Future of Radiology," Radiological Society of North America, Chicago, 1921.

"The Action of Radiation on Tonsillar and Hypertrophied Tissue," Southwestern Med., May, 1922.

"Protecting Patients from the High Voltage Line," Los Angeles Co. Med. Soc., 1922.

"Protection of the Operator from Unnecessary Radium Radiation," Am. Jour. Roentgenol., 1922.

"President's Address," Radiological Society of North America, Detroit, 1922.

"Superradiation with Voltages of 200,000 and Over," Southwestern Med., February, 1923.

"The Therapeutic Aspect of Short Wave X-rays," Calif. St. Jour. Med., October, 1923.

"Further Remarks on Protective Measures, with Special Reference to High Voltage," Radiological Society of North America, June, 1923.

"Deep Therapy X-ray in Cancer of the Prostate," Urol. and Cutan. Rev., May, 1924.

"Basic Factors in High Voltage X-ray Therapy," Radiological Society of North America, 1924.

"Short Wave X-rays in Other Than Deep Conditions," written with W. E. Costolow, M.D., RADIOLOGY, July, 1924.

"A Few Remarks on the Cancer Problem," public address over radio, Detroit, 1924.

"The Modern Conception of the Value of X-rays and Radium in Uterine Malignancy," Calif. St. Med. Soc., May, 1924.

"Comments on the Use of Radium for Intra-oral Cancer," Jour. Am. Med. Assn., August, 1924.

"Roentgen or X-rays in Medicine," Better Health, November, 1924.

"The Treatment of Inoperable Cancer of the Pelvis by Radium," Am. Jour. Roentgenol. and Rad. Ther., October, 1924.

"A Section on Radiology in the American Medical Association," editorial in RADIOLOGY, August, 1924.

"American College of Radiology," editorial, RADIOLOGY, August, 1924.

"A Radiological Retrospect," RADIOLOGY, October, 1925.

"The Cancer Problem of the Female Breast: An Analysis Based upon 25 Years' Personal Experience with Radiation Therapy," Acta Radiologica, Oct. 15, 1925.

"The First International Congress of Radiology," editorial, RADIOLOGY, September, 1925.

"Granulomas: Hodgkin's Disease, Lymphosarcoma, and Leukemia," RADIOLOGY, November, 1925.

"Radium Radiation from a General Utility Standpoint," RADIOLOGY, April, 1926.

"The Idiosyncrasies of Radiation with Reference to Irregular and Delayed Reactions," Acta Radiologica, 1926, VII.

"Radiation in the Treatment of Bone Tumors," written with W. E. Costolow, M.D., RADIOLOGY, July, 1926.

"The Treatment of Cancer of the Breast from the Viewpoint of a Radiologist," British Jour. Radiol., December, 1926.

"Recurrent Cancer of Thyroid, with Involvement of Trachea and General Metastasis," Archives of Clinical Cancer Research, March, 1926.

"Comments on the Use of Radium for Intra-oral Cancer," Archives of Clinical Cancer Research, March, 1926.

"The Present-day Status of Roentgen-ray Therapy in Breast Malignancy," RADIOLOGY, 1926.

"Radiation Therapy in Hyperthyroidism," with W. E. Costolow, M.D., and O. N. Meland, M.D., Radiological Society of North America, 1926.

"Co-ordination and Co-operation in Radiology," editorial, RADIOLOGY, 1926.

"The Metallic Colloids in the Treatment of Cancer: Preliminary Report," with W. E. Costolow, M.D., and O. N. Meland, M.D., RADIOLOGY, June, 1927.

"The Natural and Mental Hazards of Radiology," Jour. Am. Med. Assn., Feb. 19, 1927.

"Radiation Treatment of Skin Infections," Urol. and Cutan. Rev., January, 1927.

"The X-ray's Contribution to Medicine," Better Health, May, 1927.

"Chairman's Address," Section on Radiology, American Medical Association, 1927.

"President's Address," American Radium Society, Washington, May, 1927.

"The Trend of Modern Therapeutics," with W. E. Costolow, M.D., and O. N. Meland, M.D., British Jour. Radiol., February, 1928.

"Radium Treatment of Epulis," with W. E. Costolow, M.D., and O. N. Meland, M.D., Radiological Rev., March, 1928.

"The Use and Abuse of Radium Implants," with W. E. Costolow, M.D., and O. N. Meland, M.D., Minneapolis, June, 1928.

"Advanced Cancer—Experience in its Treatment with Colloidal Lead," with W. E. Costolow, M.D., and O. N. Meland, M.D., Calif. and Western Med., February, 1928.

"The Use of Colloidal Lead in Conjunction with Radiation in the Treatment of Cancer," Radiological Society of North America, 1928.

"'The Radiological Special,' to the Second International Congress of Radiology," Stockholm, Sweden, 1928.

"Radiation Therapy of Bone Tumors," with W. E. Costolow, M.D., Radiological Society of North America, 1928.

"Radium Treatment of Skin Infections," with W. E. Costolow, M.D., American Medical Association, 1928.

"Carcinoma of the Breast," Los Angeles Co. Med. Assn., 1928.

"Further Studies upon the Administration of Colloidal Lead Combined with X-rays and Radium in the Treatment of Cancer," with W. E. Costolow, M.D., and O. N. Meland, M.D., American Medical Association, Minneapolis, 1928.

"Thermogenesis by Radio Frequency Currents," Acta Radiologica, 1929, IX.

"Kritische Ubersicht über die Erfolge der Strahlentherapie beim Basedowkropf und bei der Toxischen Struma," with W. E. Costolow, M.D., and O. N. Meland, M.D., Strahlentherapie, 1929.

"Thermogenesis by Radio Frequency Currents," with A. H. Warner, Ph.D., Calif. and Western Med., January, 1929.

"Comparative Notes on Radon Implants," with W. E. Costolow, M.D., and O. N. Meland, M.D., RADIOLOGY, January, 1929.

"Colloidal Lead Combined with X-rays and Radium in Treatment of Cancer: Further Studies," with W. E. Costolow, M.D., and O. N. Meland, M.D., Jour. Am. Med. Assn., Jan. 12, 1929.

"Radiation Treatment of Certain Kidney Disorders," with W. E. Costolow, M.D., and O. N. Meland, M.D., Calif. and Western Med., February, 1929.

"The Rôle of Radiation Therapy in Pelvic Infections," with W. E. Costolow, M.D., and O. N. Meland, M.D., RADIOLOGY, March, 1929.

"Radiation Treatment of Uterine Fibromyomas," with W. E. Costolow, M.D., and O. N. Meland, M.D., Calif. and Western Med., April, 1929.

"The Present Status of Roentgen-ray Therapy in Breast Malignancy," RADIOLOGY, November, 1929.

"Some Economic Aspects of the Cancer Problem," Radiological Society of North America, Toronto, 1929.

"The Importance of Radiation Therapy to the Practice of Medicine," with E. J. Bailey, M.D., Arizona St. Med. Soc., 1929.

"Cancer Clinics," editorial, RADIOLOGY, 1929.

"Radiation Treatment of Carcinoma of Uterus," with W. E. Costolow, M.D., Calif. Med. Assn., 1929.

"Radiation Treatment of Uterine Malignancy," with W. E. Costolow, M.D., Calif. Med. Assn. (Gynecology), 1929.

"Radiation Service in the Modern Hospital," with O. N. Meland, M.D., Jour. Am. Med. Assn., Jan. 25, 1930.

"Carcinoma of the Uterus—Its Treatment by Radiation," with W. E. Costolow, M.D., Calif. and Western Med., February, 1930.

"Wholesome Co-operation," RADIOLOGY, February, 1930.

"Cancer of the Breast," Jour. Cancer Research, March, 1930.

"Notes on the Etiology of Cancer," Am. Jour. Surg., March, 1930.

"Radium Treatment of Epulis," with W. E. Costolow, M.D., Am. Jour. Roentgenol. and Rad. Ther., June, 1930.

"Intra-oral Cancer and its Treatment," with O. N. Meland, M.D., Calif. and Western Med., August, 1930.

"An Adjunct in the Care and Treatment of Cancer," Radiological Society of North America, 1930.

"The Place of Radiotherapy in the Treatment of Toxic Thyroid Disease," with W. E. Costolow, M.D., and O. N. Meland, M.D., Am. Jour. Surg., August, 1930.

"The Treatment of Carcinoma of the Breast by Interstitial Radiation," Calif. Med. Assn., 1930.

"Comments on Cancer Treatment," Illinois Med. Jour., February, 1931.

"Reactions of Radiation," Radiological Review, 1931.

"Radiology," Western Hospital and Nurses' Review, February, 1931.

"Neoplastic Pathology of the Oral Cavity," Calif. St. Dental Soc. Jour., November, 1931.

"Third International Congress of Radiology, Paris, 1931," editorial, RADIOLOGY, October, 1931.

"Oral Pathology," College of Dentistry, 1931.

"The Soiland Clinic," Bulletin, American Society for the Control of Cancer, 1931.

"The Management of Breast Cancer," Jour. Am. Med. Assn., March 5, 1932.

"Radium," editorial, Jour. of Phi Rho Sigma, August, 1932.

"The Radiologist as Key Man in Cancer Work," Texas Radiological Society, May, 1932.

"Cancer of the Breast," editorial, Radiological Review, May, 1932.

"Management of Cancer of the Breast," New Mexico Med. Soc., May, 1932.

"Importance of Early Diagnosis and Treatment of Lesions of the Oral Cavity," Texas St. Med. Assn. Jour., May, 1932.

"Management of Cancer of the Breast," Southwestern Medicine, December, 1932.

"Experimental Clinical Research Work with X-ray Voltages above 500,000," RADIOLOGY, February, 1933.

"A Radiological Concept of the Treatment of Cancer of the Breast," Pan-American Med. Assn. Congress, Dallas, Texas, March, 1933.

"The Diagnosis and Treatment of Cancer of the Breast," Arizona St. Med. Assn., Tucson, Arizona, April, 1933.

In 1928 he prepared a book, published by D. Appleton & Co., which was intended to convey information to the public on the cancer problem. It was entitled, "Cancer—A Professional Responsibility and a Public Liability."

BENJAMIN H. ORNDOFF, M.D.

This bibliography of the written papers of Dr. Soiland is a record of splendid achievement. It goes further to prove the opening words of Dr. Orndoff's "Appreciation," wherein he says: "Dr. Soiland . . . a noted trainer of students, himself an eminent student."

RECENT PROGRESS AND PRESENT STATUS OF RADIOLOGY

PRESIDENT'S ADDRESS AT ANNUAL CONVOCATION OF THE AMERICAN COLLEGE OF RADIOLOGY[1]

By ARTHUR C. CHRISTIE, M.D., WASHINGTON, D. C.

THE American College of Radiology has been in existence for nine years, a period which has been of great importance in the development of this specialty. Progress in radiology has been so rapid that it is well for us to pause long enough to examine our present condition and to consider means for consolidating the gains we have made.

Since 1923, the year in which the College was organized, there have been several notable contributions to the art of radiology. One of the most important was the discovery and perfection of a method of cholecystography. The original communication on this subject by Graham, Cole, and Copher was published in 1924. It is now a routine method of examination and its value and limitations are practically established. More recently a new method of pyelography has been developed by means of the intravenous injection of an opaque salt which is excreted by the kidneys. It will undoubtedly replace the retrograde method in a considerable percentage of cases and it constitutes a real advance in urology. Within the past two years a method for examination of the liver and spleen has been devised, also depending upon intravenous injection of an opaque salt. It is not comparable in its practical value to either cholecystography or pyelography but it has a certain practical use and may prove of permanent value in investigation of the reticulo-endothelial system. The use of iodized oils for investigation of the bronchial tree is another method which is of great value and which has been so simplified in the past few years that it is now used routinely by the roentgenologist. These specific instances of progress fall far short of telling the whole story of the advancement in the field of diagnostic roentgenology in the years immediately past. The greatest advance of all in this field lies in the increased ability of roentgenologists to interpret accurately their findings, in a more definite conception of the limitations of the roentgen method, and in a much broader knowledge of clinical medicine on the part of roentgenologists. We are, in fact, more and more occupying the place of clinical consultants who have the special ability to interpret roentgenologic findings.

In the field of roentgen and radium therapy the advances during the past nine years have been not less striking than those which have occurred in the diagnostic field. During that time there has been developed and accepted throughout the world a standard unit of measurement, the "roentgen." It enables individuals not only to measure dosage more accurately and to profit by their own experience by being able to duplicate accurately their own work, but it makes possible an interchange of results obtained anywhere in the world. If this were the only accomplishment to the credit of our International Congresses of Radiology, the holding of such congresses would be more than justified.

Useful improvements have been made also in apparatus; x-ray films are more dependable, intensifying screens are more uniform and durable, and x-ray tubes are of better construction and are available in types adapted to a greater variety of purposes. We have reached a degree of perfection in the construction of apparatus and a precision in the application of the two powerful agents, the x-ray and radium, which are

[1]Delivered May 11, 1932, at New Orleans, La.

hardly excelled in any practical or scientific field.

The years immediately past have witnessed a remarkable advance in the treatment of cancer. Although there is still little to offer for the cure of cancer of the lungs, stomach, or liver, on the other hand great strides have been made in the cure of cancer of the lip, tongue, fauces and neck, the breast, and the uterus. The advancement has taken place in the perfection of the use of the x-ray and radium in these regions. A few years ago only a few were convinced of the value of deep x-ray therapy in treatment of cancer of the breast; now, only a few remain unconvinced. It is a well-known fact that, in this disease, as well as in cancer of the mouth and neck, the field of irradiation has widened while that of surgery has been rapidly curtailed. The surgeon has long admitted the efficacy of irradiation in inoperable cases in these regions; the real change in the past few years consists in a re-definition of "operability." There is no better illustration of this gradual change in position than Douglas Quick's statement of the modification of his own practice in the treatment of cancer of the tongue. In discussing several papers in a "Symposium on Intraoral Cancer" at the meeting of the American Radium Society last year Dr. Quick made the following remarks:

"I cannot help recalling a similar group of papers presented before this Society at one of its meetings about ten years ago. The contrast is striking to say the least. It is evident that the viewpoints of various operators have come much more closely together and that there is to-day a grasp of the fundamentals of radiation recognized and accepted by all, that were scarcely thought of a few years ago."

And again from the same discussion:

"Relative to the treatment of the neck, I believe we all recognize it as perhaps more important in a relative way—certainly so in a great many of the cases—than the treatment of the primary growth itself. I believe it is safe to say that more cancer clinicians are coming to take a more conservative view of this problem of the treatment of the neck as time goes along. From Dr. Simmons' paper it is evident that but a very small percentage, at best, of cases coming routinely under observation are amenable to the classical surgical procedure which has generally been accepted in the strictly surgical field for nearly a generation. With more accurate knowledge of dosage intensities, with the aid of histological differentiation as a guide to the probable intensities required, and with improving external irradiation it would seem that less and less of radical neck surgery is indicated."

It is clear that the same evolution of practice which has taken place in the treatment of cancer of the tongue and its cervical extension is now rapidly occurring in the management of breast cancer and its axillary and supraclavicular involvements. Ewing's estimate that only one out of twenty-five women escape recurrence after a radical breast operation undertaken after the axillary nodes are involved, is supported by statistics from many different sources. Such a condition furnishes adequate reason for prompt modification of our criteria of operability in breast cancer.

You are all acquainted with the numerous improvements that have developed recently in the irradiation treatment of cancer of the breast. We have learned how to administer our pre-operative and post-operative roentgen dosage without damaging the lungs or lowering the patient's general resistance to a dangerous degree. The greatest advance, however, has taken place in methods of interstitial application of radium. The bad results of a few years ago due to localized necrosis and subsequent infection because of inadequate filtration, or dosage which was too high in isolated areas, or both, have been overcome by the use of gold or platinum radon seeds or very small radium needles

with adequate filtration. The second difficulty, that of uneven distribution of the interstitially placed seeds or needles, has been largely overcome by the use of gold tubes for the radon or long platinum needles in which a small quantity of radium is evenly distributed. With such improvements and numerous others with which you are all familiar, it is not too much to say that the treatment of cancer of the breast is rapidly approaching a place quite comparable to that now adopted by Dr. Quick and his associates in the treatment of cancer of the mouth and neck; a position where irradiation occupies the most important place and surgical procedures, when used at all, are secondary. Every one of experience has now learned that there is no stereotyped method of treatment of cancer applicable to all cases. It is only by careful study of each case and skillful application of the roentgen ray, radium, and surgery when indicated, in their proper sequence, that the best possible results in the present state of our knowledge and experience are to be attained.

There are other fields in which there have been recent advances in roentgen and radium therapy about which I have little time to speak. There is no doubt, for instance, that every radiologist of adequate experience is now convinced that irradiation by means of the roentgen ray or radium will bring about a cure in a large majority of cases of hyperthyroidism. Results are undergoing improvement in the hands of various operators by attention to certain details of technic which have not been sufficiently emphasized heretofore. Inadequate dosage has been a cause of failure on the part of some, either because of their own failure to appreciate the amount of irradiation necessary to secure a cure, or to the fact that the patient has been persuaded to seek surgery before adequate irradiation has been given. Another important cause of failure has been neglect to treat large enough areas. It has been shown that thyroid tissue may be distributed from the angles of the jaw down to the aortic arch. This points to at least one reason why it is necessary to apply radiation over the upper sternal area as well as over both sides of the neck.

Recently the relationship of cystic disease of the bones to the parathyroids has been brought out and reports will soon be forthcoming of beneficial effects upon osteitis fibrosa cystica by means of irradiation of the parathyroids. More recently still there have been reports of the diagnostic and prognostic value of the Aschheim-Zondek test in teratomas located in the testicle, ovary, or retroperitoneal region. The effect of irradiation upon these tumors is shown very definitely by the disappearance of the pituitary hormone from the urine after irradiation.

It is not my intention to present a complete review of the recent advances in radiology but only to call your attention to the fact that progress is taking place in many and diverse directions and that all of us interested in this specialty must be constantly alert to adjust ourselves to rapidly changing conditions.

Along with the advances in the art and science of radiology many changes have taken place in the organization of radiologists and in their relation to the remainder of the medical profession, to hospitals and to the laity. Nine years ago, when this College was organized, there was widespread apprehension on the part of radiologists that all of this work would be taken over by clinicians and that radiology could not develop as a separate medical specialty. It is apparent now that this fear was never justified. The field is so broad, experience in interpreting results is so necessary, and the technical aspects of the work are so exacting, that satisfactory work in radiology can be accomplished only by those who devote their entire time to it.

Another source of apprehension which is not yet allayed is the commercial x-ray laboratory. It seems clear now that very little can be accomplished by way of control or extermination of these pernicious organizations by laws or regulations. They can always evade regulations by securing the help of some unprincipled member of our profession who is licensed to practise medicine. Since, then, we cannot summarily rid ourselves of such organizations we must resort to the slower processes of education. Just as the bootlegger is entirely dependent for his existence upon those who buy liquor from him, so the commercial x-ray laboratory is dependent upon the physician who refers patients to it. Our process of education of the physician must begin in the medical school while he is still a student. It is my opinion that education in radiology should begin in the student's freshman year, in his courses in anatomy and physiology, and should extend through his entire college course and his interneship. It is only so that a man will go out into the practice of medicine with a realization of the importance of radiology to him and his patient. I believe it is possible by careful and persistent methods of education to turn out our students with such an appreciation of the possibilities of radiology that only the very small percentage who are unprincipled will turn to commercial laboratories. The older men in the profession must be kept informed through our medical societies and by our personal contact with them. The same methods must be used to combat the tendency in industrial medicine and compensation work to have roentgenologic work done in clinics controlled by laymen. It is evident to many of us now that compensation work which insurance companies have been referring to commercial clinics, where inadequate x-ray work is done, is rapidly returning to qualified radiologists. I am convinced that the only permanent cure for the commercial x-ray laboratory lies in the education of the physician and a type of work among legitimate radiologists with which commercial laboratories cannot compete.

I said a moment ago that it was inevitable that radiology should eventually become established as a specialty in medicine. The accomplishment of this end has been greatly furthered by the attitude which the American Medical Association has assumed. In the year 1924 there was established the Section of Radiology of the American Medical Association. We who are Fellows of the American College of Radiology ought not to forget that one of our own Fellows, who was himself the organizer of this College and later its Executive Secretary and to-night its President-elect, was the one who took it upon himself, as a delegate from his own State, to present a resolution in the House of Delegates of the American Medical Association for the creation of a Section on Radiology. Radiologists are only now beginning to realize how much we are indebted to Dr. Albert Soiland for this action which has done more than any other one influence to give the radiologist a standing in organized medicine. Since that day the American Medical Association has been our friend, and has fought our battles for us. Through the Council on Medical Education and Hospitals it has laid down the principle that "the practice of radiology is the practice of medicine," a principle which will gradually be recognized by accrediting agencies and by courts of law. It will be increasingly operative in improving the status of radiologists in their relations to hospitals and will prevent other accrediting agencies from discriminating against the radiologist by making him a hired man of the hospital.

The American Medical Association through the above-mentioned Council has also set up standards for radiological clinics and departments and publishes lists of accepted radiologists. As the practical details

are further worked out this will be of great benefit to the qualified radiologists all over the country.

The latest effort of the American Medical Association in behalf of radiology is to improve methods of education in this specialty. At the meeting of the Council on Medical Education and Hospitals, in February of this year, papers were read by Dr. Case, Dr. Desjardins, and Dr. Pancoast on various phases of education in radiology and were later published in a special Radiologic Number of the *Journal of the American Medical Association.*

There is still another service that the Section on Radiology of the American Medical Association can perform for our specialty. The time is now ripe for the formation of a board for the certification of radiologists in the United States. Several other specialties now have such boards and they have operated to the great advantage of those specialties. It is my intention to present a resolution before the Section which, if passed, will ask the co-operation of this College, the American Roentgen Ray Society, and the Radiological Society of North America in the formation of a Board for Certification of Radiologists. I am to read a paper on that subject before the Section and shall later present the resolution.

It may seem strange to you that I, as the President of the College, am not requesting the initiative in this matter on the part of the College, but it seemed a much more appropriate plan that I should ask the Section, which includes practically all radiologists, to take the initiative and ask the co-operation of the other important radiological organizations. I hope that we will promptly approve it if and when it is returned to us. I recommend that the Board of Chancellors be given power to act in the matter.

And now, in conclusion, let me say this in regard to the work of the American College of Radiology. We have consummated plans during this past year which had their inception when this College was organized. Indeed, it is stated in our constitution as one of the objects of the College, namely, the sponsoring of an American Congress on Radiology. The College is to be congratulated upon the magnanimous way in which it operated to bring about the organization of the Congress. The object of the College is to secure the co-operation and the joint meeting of a great Congress at the Century of Progress Exposition in Chicago next year. We have brought about the formation of a committee formed of an equal number of members from the College, the American Roentgen Ray Society, the American Radium Society, and the Radiological Society of North America. You observe that, although the plan was conceived in the College, we asked only equal representation with the other organizations. The committee, made up of Dr. Orndoff, Dr. Jenkinson Dr. Case, Dr. Hubeny, Dr. Jackson, Dr. Kirklin, Dr. Menville, Dr. Murphy, Dr. Pfahler, Dr. Reynolds, Dr. Schmitz, and Dr. Soiland, met and organized. It appointed Dr. B. H. Orndoff as Chairman and Dr. E. L. Jenkinson as Secretary and elected Dr. H. K. Pancoast as President of the Congress. The College contributed the sum of $100 for the initial expenses of the committee, a like amount being contributed by each of the other sponsoring organizations. Later, when it was apparent that funds would be needed in a much larger amount before registrations could be expected, the Chancellors of the College voted to loan to the committee for the Congress the sum of $1,500.

Through all of these actions the College has not only initiated the Congress but has contributed largely to its success by supporting it in its initial stages.

It seems to me that the action here taken points the way in which the American College of Radiology can be of great service to

the cause of radiology throughout our country; by not seeking its own aggrandizement but by magnanimously giving itself in service to the cause which is of vital importance to all of us, it will finally achieve a lasting place of honor.

I now relinquish my position as President of the College with grateful thanks for the honor conferred in elevating me to this position. It gives me great pleasure to turn over the gavel to the President-elect, Dr. Albert Soiland, who now becomes the President of the College.

ANNOUNCEMENTS

SECTION ON RADIOLOGY, MEDICAL SOCIETY OF THE STATE OF NEW YORK

The House of Delegates of the Medical Society of the State of New York at a meeting held April 3, 1933, established a Section on Radiology.

The officers for this Section are: *Chairman,* Joseph M. Steiner, M.D., of New York; *Vice-chairman,* Donald S. Childs, M.D., of Syracuse; *Secretary,* Leo P. Larkin, M.D., of Ithaca.

The organization of this Section on Radiology offers further concrete evidence of the growing interest of the medical profession in radiology.

AMERICAN CONGRESS OF RADIOLOGY

Dr. George E. Pfahler, 1930 Chestnut St., Philadelphia, is Chairman of the Committee on Scientific Program, and it is to him that correspondence in regard to the program should be addressed.

ANNOUNCEMENT OF AWARD

A David Anderson-Berry Gold Medal, together with a sum of money amounting to about £100, will be awarded in July, 1935, by the Royal Society of Edinburgh, to the person who, in the opinion of the Council, has recently produced the best work on the nature of x-rays in their therapeutic effect on human diseases.

A similar award will be made every three years. A further notice will be published early in 1935.

BOOK REVIEWS

LES MALADIES DE LUMIÈRE ET LEUR TRAITEMENT. By HUBERT JAUSION, Professeur agrégé libre du Val-de-Grâce, Médecin de l'Hôpital Villemin, and FRANÇOIS PAGÈS, Ancien externe des Hôpitaux de Paris. Preface by Dr. CLÉMENT SIMON. Pages 204, with 45 illustrations and 11 tables. Published by Masson et Cie., Paris, 1933. Price, 45 francs.

For several years artificial sources of ultra-violet radiation have been commercially over-exploited and much of this has been based on the fortuitous assumption that sunlight and its artificial relatives, the ultra-violet rays, can do no harm. Many physicians, notably dermatologists and others who have devoted special attention to natural and artificial heliotherapy, have been aware that indiscriminate exposure to sunlight or to ultra-violet rays from artificial sources of different kinds is not always free from injurious effects. This book is a pertinent reminder of the possible danger from sunlight or its artificial congeners. The authors have made a most timely contribution to our knowledge of the different forms of cutaneous and other disorders which may be caused by actinotherapy under certain conditions. The different chapters take up briefly, but adequately, the subject of light in general, the reactions of the organism to light, sensitization to light by various chemical substances, and therapeutic sensitization to light. The remaining chapters, constituting three-fourths of the book, are devoted to a classification of the diseases, mostly dermatoses, caused by exposure to light, and to the treatment of such pathologic effects. The book is well illustrated by numerous photographs, and an extensive bibliography is appended.

The dermatologist and the radiologist will

find in this work much valuable information which, heretofore, has been available only in scattered articles in numerous publications, in different languages.

MANUEL DE CURIETHÉRAPIE. By LÉON IMBERT, Professeur à la Faculté de Médecine de Marseille, and RAYMOND IMBERT, Chef de Clinique. Pages 216, with 21 figures, mostly diagrammatic. Published by Masson et Cie., Paris, 1932. Price, 22 francs.

This little book does not pretend to be a treatise on radium and its therapeutic applications, neither is it intended as a textbook. Its object is to present to the general practitioner the subject of radium therapy in as simple and as understandable a form as possible. All controversial questions have been wisely excluded. The authors assume that since many surgeons and general practitioners do not hesitate to undertake to treat with radium such of their patients as may require treatment of this kind, they need a simple manual to give them the basic physical and other principles on which such work rests. The authors have distinctly fulfilled their object with a considerable degree of success. It is permissible to question the advisability of encouraging general practitioners to undertake radium treatment, but after going over this manual, the impression is that it will probably lead surgeons and other physicians to refer their cases to a specialist rather than to attempt to treat them themselves. Some may be surprised by the authors' failure to mention the exceptional radiosensitiveness of endothelioma of bone. Also, the dogmatic assertion that mixed tumors of the testis must be classed among the less radiosensitive tumors. Another point which will find many dissenters is their advocacy of biopsy in most, if not in all, cases. In spite of these few possible lapses, this small book is well considered and will furnish valuable information to those readers who seek to understand the fundamental principles of the subject.

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BONE DISEASES (DIAGNOSIS)

Osseous Changes in Hyperparathyroidism: A Roentgenologic Study. John D. Camp. Jour. Am. Med. Assn., Dec. 3, 1932, XCIX, 1913-1917.

The predominating osseous changes described as co-existent with disease of the parathyroid glands are generalized atrophy and multiple cystic lesions. Experimentally, injection of parathyroid extract into animals has produced identical histologic and roentgenologic changes in bone. Clinically and experimentally these fundamental changes can be altered and restoration toward normal produced by the removal of the cause of the hyperparathyroidism. Generalized osteitis fibrosa cystica (Recklinghausen's disease) apparently is the result of chronic hyperparathyroidism; the usual roentgenographic picture is undoubtedly a late manifestation of the disease. Satisfactory proof of hyperparathyroidism due to associated parathyroid tumors is established in generalized osteitis fibrosa. Data based on ten cases are reviewed: in three, a parathyroid tumor was removed surgically, followed by symptomatic relief and obvious changes in the post-operative roentgenograms. Besides the changes in the skeletal system, renal calculi or areas of calcification within the kidney were revealed in four cases: in one, small deposits of calcium were observed throughout the lungs. No other generalized skeletal lesion exactly simulates the miliary mottling and granular appearance of the bone in hyperparathyroidism. The change is best exhibited in flat bones, especially the calvarium. The resorption of calcium causes the bone trabeculæ to become indistinct in outline and the cortical bone to be thinned; in early cases the bones have a homogeneous ground-glass appearance. In more advanced cases multiple cystic areas may be found within the medullary portion or below the periosteum; these may reach a large size and become the site of pathologic fractures. Because the bones are soft, bowing, kyphosis, narrowing of the pelvis and coxa vara are common. The changes observed in the skull, long bones, spinal column, pelvis, hands, and feet are described in detail. Following the removal of a parathyroid tumor the resorption of calcium is arrested, the bone trabeculæ lose their indistinct outline, and, as convalescence occurs, the bone gradually approaches the normal in density. The margins of cystic lesions are gradually filled in by normal bone, and may ultimately disappear. Hyperplasia of the parathyroid bodies produced diffuse osteoporosis of the bones, but the miliary granular appearance seen in the cases associated with parathyroid tumors was not present. It is possible these changes were early manifestations of hyperparathyroidism, as cysts had not formed.

Reynolds pointed out in discussion that in the investigation of lead poisoning the injection of parathyroid extract enabled mobilization of lead in the bones. This stimulated the interest in parathyroid disturbance. The Harper Hospital group found the earliest and most easily recognized changes in the spine, a ground-glass appearance of the vertebræ with a reduction of their size. In examination of the spine in cases of low back pain, hyperparathyroidism must be kept in mind. Morse warned that osteomalacia and rickets are not of parathyroid origin and osteogenesis imperfecta and fragilitas ossium are due to congenital defects from the inability of the osteoblasts to lay down proper ground substances. The fractures of osteogenesis imperfecta heal promptly because the calcium metabolism is normal. He considered osteitis fibrosa cystica, leontiasis ossium, and Paget's disease as one disease and of parathyroid origin. Gates stated that failure to find an adenoma of the parathyroid gland at operation does not imply that a clinical and roentgenologic diagnosis is in error. He cited one case in which the parathyroid adenoma was found in the superior mediastinum between the trachea and esophagus.

C. G. Sutherland, M.D.

CANCER (THERAPY)

The Radiosensitivity of Carcinoma of the Bronchus. G. Herrnheiser. Strahlentherapie, 1932, XLV, 269-280.

Carcinoma of the bronchus sometimes responds well to roentgen rays and should, therefore, be treated if the condition of the patient permits. The diagnostic phase is briefly discussed and a few illustrative roentgenograms are shown. The reappearance of normal lung markings does not always mean *restitutio ad integrum*. Two case histories are appended. A dose of about 4,500 r of highly filtered radiation may be administered, according to the protracted fractional dose method or according to the saturation method.

Ernst A. Pohle, M.D., Ph.D.

CHEST (DIAGNOSIS)

The Radiologic Signs of Metastatic Tumors in the Lung. R. Rossoni. Rivista di pathologia e clinica della tubercolosi, 1932, VI, 361.

The author differentiates a miliary, a lymphangitic, a productive, and an infiltrative type of pulmonary metastasis. He describes 14 cases in which there was no clinical sign of metastasis yet in which the radiograph of the chest was positive. He points out the value of repeated examination in doubtful cases, for by it the progress of the malignant lesion can be demonstrated. Since pulmonary metastases are often silent, the author advises a routine x-ray examination of the chest to eliminate the possibility of metastasis before any radical (surgical) curative procedure is carried out.

E. T. Leddy, M.D.

Pneumonia Due to the Aspiration of Lipoids. John W. Pierson. Jour. Am. Med. Assn., Oct. 1, 1932, XCIX, 1163-1165.

The extensive use of oils in pediatric practice, both as food and for therapeutic purposes, has been attended in some instances with unexpected pulmonary complications. Given either orally or through the nasopharynx, oil infrequently passes into the trachea and ultimately reaches the alveoli of the lungs, initiating an interesting pathologic process. Oil is actively phagocyted by endothelial cells, which are present in sufficient numbers to dispose of all the oil present and produce consolidation of the lung. There is a tremendous variation in the roentgenographic picture, depending on the phase of the disease at the time of examination, *i.e.*, before or after it is complicated by acute pneumonia. The differential diagnosis can rarely be made from a single film, but only by viewing the films in series and carefully considering the patient's history.

C. G. Sutherland, M.D.

CONTRAST MEDIA

Reports of the Council on Pharmacy and Chemistry. Dangers of the Injection of Iodized Oils. Jour. Am. Med. Assn., Dec. 3, 1932, XCIX, 1946, 1947.

Mechanical Difficulties.—Technically, the immiscibility of iodized oils with water prevents perfect outlines if watery fluids are present. Their viscosity may hinder even distribution, and it necessitates relatively high pressures for injections, which it may not be easy to control. Both factors render the removal of the injected oil difficult; and, as the absorption of oils is extremely slow, some of the material tends to remain indefinitely, especially in closed cavities, and to act at least mechanically as a foreign body. If injected into the bronchioles, the oils also tend to diminish the active lung area.

Tuberculous Reaction.—In tuberculosis of the lungs and upper respiratory tract, injection of iodized oil may give rise to fever and other complications, which have proved fatal in some cases, presumably by the special irritative response of the tuberculous process to iodine. Similarly, intrapleural injection of from 1 to 2 c.c. has resulted in long continued rise of temperature.

Direct Irritation.—The least irritant causes a considerable rise of the spinal fluid cell count and more serious and persistent damage has been found. Intracisternal injection gave definite evidence of leptomeningeal reaction. Injection of iodized oil into the subarachnoid space is to be regarded as a dangerous procedure. Much greater irritation is produced by oils that have undergone deterioration, by exposure to light or heat, as indicated by darkening of color. It is conceivable that similar changes occur when the oil is left in the tissues, but the decomposition products are probably absorbed before they reach a harmful concentration. Serious damage from this source need not be apprehended, outside of the neurologic use.

Oil embolism is another source of potential danger. It may occur in any situation if the injection is made under excessive pressure, and even with moderate pressures in the case of uterine and renal pelves. In hysterosalpingography, oil injected into the uterine cavity in moderate amount and without excessive pressure, in living patients, may produce gross injection of the veins. Uterine injections should be made under fluoroscopic control. Oil embolism could occur through the "pyelovenous backflow," the direct communication between the renal pelvis and the blood vessels. Altogether, there are so many objections to the use of iodized oils for pyelography that the risk does not seem advisable. With the emulsion, the diagnostic results appear sufficiently promising to make their consideration possible. It is conceivable that emulsions may be safe in intravascular injection of iodized oil, though further confirmation should be awaited.

C. G. Sutherland, M.D.

DOSAGE

The Skin Tolerance of "Slow Irradiation" in Almost Undivided Application (within 24 Hours): The Influence of the Change of the Number of r per Minute on the Skin Reaction if Applied in One Sitting and in Fractional Doses. Rudolf Pape. Strahlentherapie, 1932, XLV, 461-486.

The author studied the skin tolerance of patients to deep therapy radiation, differentiating between two types of treatments. In one, the total dose was applied in one sitting, giving 6 r per minute and considering the permissible total dose 1200 r. When dividing this dose 700 r can be given twice at 24-hour intervals with 10 r per minute. This dose can be repeated after three months. He calls this permissible dose the serial grenz dose in contradistinction to the so-called absolute or maximal grenz dose, which can be given only once and should not be repeated. As example is quoted: 2×800 r at 10 r per minute applied at intervals of from three to six hours. The upper safe limit is probably 2×1000 r given at an interval of 24 hours. Based on his observations the author comes, however, to the conclusion that the method of choice is the fractional dose method. Six brief case histories are appended, with photographs of the skin reactions.

In the second part of the paper observations made on five cases are recorded. Two skin fields were exposed to the same dose, while the number of r per minute varied in the proportion of 1:2.67. It was apparent that the field which received the smaller number of r per minute showed much less reaction.

Ernst A. Pohle, M.D., Ph.D.

The Influence of Roentgen Rays on the Liver Function. A. Beutel. Strahlentherapie, 1932, XLV, 344-348.

Bromeis reported recently the presence of urobilinogen in the urine of 70 per cent of patients following deep therapy not applied over the liver and in about 74 per cent of patients who underwent gastro-intestinal x-ray examination. The author could not verify these observations and therefore exposed six patients over the liver area (80 K.V., 1 mm. Al) to 150 r and six other patients to 300 r over the liver. In six out of 12 cases there was a definite increase of the bilirubin in the blood; four cases did not show any changes and in two cases there was a drop. The function was studied by means of the galactose test which was positive in only one patient, who had a bladder tumor.

ERNST A. POHLE, M.D., Ph.D.

The Question of Measuring Potential Continuously in Roentgentherapy Laboratories. A. Determann. Strahlentherapie, 1932, XLV, 371-379.

The author carried out comparative measurements with the high tension voltmeter designed by Starke and Schroeder, the Seemann's spectrograph, and the sphere gap (12.5 cm. diameter) of C. H. F. Müller. He found that the values obtained on the high tension voltmeter were accurate enough for practical purposes. Very striking were the considerable potential fluctuations on therapy machines when changing the tube current. The prereading kilovoltmeter could not be correlated with the readings shown by the high tension voltmeter. He concludes, therefore, that the prereading kilovoltmeter cannot be used as an indicator of the quality of radiation.

ERNST A. POHLE, M.D., Ph.D.

FRACTURES (THERAPY)

End-results in Fractures of the Calcaneus. Rudolph S. Reich. Jour. Am. Med. Assn., Dec. 3, 1932, XCIX, 1909-1913.

This article presents a study of the end-results in patients seen over a period of six years, only the complicated fractures comprising the basis of this report. In complicated fractures are included: (1) Fractures of the calcaneus which were comminuted and fissured, involving most of the body of the bone and extending into the subastragalar, and, in some instances, into the mediotarsal joint; (2) impacted fractures causing impingement against the bony mortise formed by the two malleoli, but chiefly against the lateral malleolus, and (3) those which resulted in spurs, mainly on the weight-bearing surface of the heel. Etiology was traceable to direct violence against the heel as the result of a fall. Careful roentgenographic study of each foot was made in several planes, with special attention to the condition of the calcaneus as demonstrated in the plantar plane, in order to determine the degree of impaction in the heel. Böhler emphasizes the breaking off of the lateral portion of the calcaneus, with a shearing off of the posterior portion of the surface articulating with the astragalus, the fragment sometimes being driven downward. Therefore, two fractures are produced in the sagittal plane, one involving the lateral wall of the bone and the other running from the medial side obliquely forward. The medial fragment, which contains the sustentaculum tali, usually remains in place, while the middle and lateral fragments are displaced laterally and appear as a hard bony mass below the lateral malleolus. The Böhler method of correction is detailed. Böhler calls attention to the normal tuber-joint angle as the criterion for the correction of the deformity. This consists of the normal angle formed by the line extending through the upper surface of the tuberosity with a line through the subastragalar joint, and ranging from 27 to 30 degrees. In comminuted fractures, either this angle becomes smaller or disappears altogether, or the tuberosity may even be raised above the joint surface. In treatment, the tuber-joint angle should be somewhat overcorrected to 35 or 40 degrees. Hammond stated, in the discussion, that roentgenologists were not recognizing fractures of the anterior process of the os calcis.

C. G. SUTHERLAND, M.D.

THE SPINE (DIAGNOSIS)

Reduced Lumbosacral Joint Space: Its Relation to Sciatic Irradiation. Paul C. Williams. Jour. Am. Med. Assn., Nov. 12, 1932, XCIX, 1677-1682.

On all patients complaining of back pain routine anteroposterior and lateral roentgenograms have been made of the dorsal, lumbar, and sacral spine, as well as an anteroposterior view of the pelvis.

Many conditions of the spine give neither subjective symptoms nor objective findings at the level of the lesion. A narrowing or a complete loss of the intervertebral disc between the fifth lumbar and first sacral vertebra was noted in a majority of patients suffering with symptoms of sciatic irritation. One hundred and seven cases of sciatica were seen in 1931; 85 had satisfactory anteroposterior and lateral roentgenograms, and 94 per cent of the 85 showed pathologic changes in the bones and joints considered sufficient to cause sciatic irritation. Generalized hypertrophic arthritis included 19 per cent of them. The only finding in 74 per cent was a narrowed lumbosacral intervertebral disc, with a localized arthritic reaction at this site. A definite technic for obtaining most satisfactory roentgenograms is described.

Differential diagnosis includes tuberculosis, congenital anomaly, and functional cessation of the

nucleus pulposus. Conservative treatment consists of immobilization of the lumbosacral joint by braces, corsets, and plaster, while the more radical treatment is immobilization by a lumbosacral fusion.

C. G. SUTHERLAND, M.D.

Roentgenologic Studies of Disturbances in the Ossification of the Vertebral Bodies. Hans Hellmer. Acta Radiologica, 1932, XIII, Fasc. 5, pp. 483 to 517.

Schmorl and his students (Dresden) have examined at autopsy, in almost ten thousand cases, the vertebral column from the fifth cervical to the fourth or fifth lumbar. Their first report was made in 1926, and concerned developmental variations, especially the changes of old age, and traumatic and inflammatory diseases of the vertebræ. Roentgen examination has been the method by which these new developments in pathology have been connected with clinical medicine. This paper is based upon clinical roentgen studies made since 1928 in the Sofiahemmet, Stockholm.

The author says that he has not been able to find persistent vertebral epiphyses in his material. He undertakes to reconcile this statement with the roentgenologic appearance commonly interpreted as persistent epiphyses of the vertebral bodies. His work has shown that the secondary epiphyses of the vertebral bodies in man are ring-shaped. In the adult this ring persists as an elevated ridge of compact bone around the border of the vertebral body, being widest in front. He proposes to apply to this ridge the name "limbus vertebræ."

Disturbances in ossification are most commonly seen in the lumbar and lower dorsal vertebræ. They may involve either the upper or the lower limbus, but most often are seen in the upper. The limbus may vary greatly in size even in adjacent vertebræ. Lateral films made with a slightly oblique central ray will often demonstrate the crescent shape of the limbus as a whole. Since 1929, various authors have described small bony fragments lying at the anterior angles of the vertebræ, which they have regarded as persistent, ununited epiphyses. In films of fine quality it is possible to demonstrate the bony structure of these fragments. As a rule the interspaces are not narrowed and the intervertebral discs are normal.

Differential diagnosis between disturbances of ossification in the limbus and fractures is difficult and important, particularly if the fracture involves only a small fragment. In disturbances of ossification of the limbus the contours of the adjacent surfaces of the fragment and of the vertebral body are similar, while in the anteroposterior view the border of the vertebral body may show a wavy outline in the region of the lesion. This is not the case in fracture, the fragment being irregular in outline in such an instance. Serial examinations of fracture cases will often show absorption of the fragment or new bone formation.

A. L. HART, M.D.

Abnormalities of the Vertebral Body. William A. Evans. Am. Jour. Roentgenol. and Rad. Ther., June, 1932, XXVII, 801-817.

This paper constitutes a comprehensive description of abnormalities of the spine considered under nine major headings: (1) Chronological changes or normal variations peculiar to certain ages; (2) developmental abnormalities; (3) changes associated with nutritional disorders; (4) traumatic changes; (5) postural or occupational changes; (6) inflammatory changes; (7) distortions of the vertebral body secondary to intervertebral disc abnormalities; (8) deformities due to constitutional disease, and (9) deformities resulting from tumors. Under chronological changes it is emphasized that there may often be localized or limited abnormalities of the bodies, due to calcification in the ligaments of the spine, which in later adult life represent a normal physiologic process but which are often confused with arthritic changes.

Differentiation between a congenital condition and a traumatic one is usually possible by demonstrating complete absence of reparative or irritative changes at the site of deformity in the former condition, while the traumatic process usually produces such changes. A wedge-shaped deformity limited to one vertebral body, particularly in the dorsal region, is not sufficient evidence to justify an assumption of fracture; certain changes in structure or outline are also usually demonstrable on films of good quality. The most common change is that of bone condensation, usually appearing at the upper margin of the involved body. Examination of the fractured body several months after injury usually reveals hypertrophic bone changes which tend to bridge the superior intervertebral space anteriorly. The fractured spine which heals without basis of disturbed function or persisting symptoms may show no irritative or reparative changes, with a preserved intervertebral cartilage and nucleus pulposus.

Osteomyelitis is a rare lesion in the spine and presents no characteristic features. The commonest postural deformity consists of a wedging of the mid-thoracic segments, with a variable degree of kyphosis.

Deformities of the body may occur as the result of abnormalities of the intervertebral disc. At times there may be marginal defects along the superior or inferior articular margins of the body, these being usually a little posterior to the midline (about 1.0 or 1.5 cm. in diameter) and representing a pressure effect of the pulpy center of the disc (or nucleus pulposus). Such changes may or may not be associated with symptoms. If the entire disc becomes thickened and enlarged, the deformity known

as "fish spine" may result, in which case the articular surfaces become concave.

Giant-cell tumor of the spine, because of the secondary changes produced in the spinal canal, may produce a markedly malignant picture clinically, even in the absence of tendency toward metastases. Metastatic carcinoma treated by combined colloidal lead injection and deep irradiation may show marked regeneration of bone, the involved areas being much denser than the normal surrounding bone.

J. E. HABBE, M.D.

Contribution to the Question: Are There Persisting Epiphyses of the Vertebræ? C. Mau. Röntgenpraxis, August, 1932, IV, 649-659.

Triangular bone shadows separated from the vertebral bodies and situated on their anterior edge have lately been described by several authors. These shadows are thought to be persisting epiphyses. Other authors are of the opinion that they are of traumatic origin or ossification in the intervertebral disc. The author reports three such cases.

In all of the cases the above described changes were found on the upper and anterior edge of one or two of the lumbar vertebræ. A history of a more or less severe trauma was present in the three patients. The shape and size of the shadows in question do not seem to resemble epiphyses. A chip fracture of the edge, with consecutive bony union, has been described by Schmorl. In some of these questionable cases this condition will probably be found if the patients are re-examined after a long enough interval. The mechanical and anatomic conditions are not favorable to a bony union, and non-union is in such cases more probable. It is possible that occasionally such findings may be explained by a form of aseptic necrosis, comparable with processes known in other parts of the skeleton.

Schmorl and Junghanns have never observed persisting epiphyses in the spine in their extensive material.

The principal clinical symptom is backache, especially on bending and working. Only the lateral examination of the spine will show the underlying pathology. Arthritic spurs and calcification in the anterior portions of the intervertebral disc can usually be excluded easily.

H. W. HEFKE, M.D.

THE STOMACH (DIAGNOSIS)

The Effect of Ephedrine upon the HumanStomach as Determined Roentgenologically. Walter W. Fray. Am. Jour. Med. Sci., September, 1931, CLXXXII, 387-395.

The author, recognizing the conflicting reports concerning the effect of ephedrine upon the human stomach, states in this article the result of his examination of 58 cases studied before and after the oral administration of ephedrine and 39 cases before and after subcutaneous injection of atropine.

Out of the total of 58 cases studied after the ingestion of ephedrine, 32 were found to be free of local disease. Out of the 39 cases given atropine, 20 showed no local lesion.

After summarizing the statistics of the findings in these cases he comes to the following conclusions:

(1) Ephedrine commonly produces a diminution in peristalsis and tone in the human stomach free of local disease.

(2) In relaxing spasm the action of ephedrine is more variable, often failing in cases of pylorospasm in stomachs free of local pathology.

(3) In stomachs showing local disease spasm is less often affected by ephedrine and less modified when affected than in normal stomachs.

(4) Ephedrine accomplishes much the same objective result that is seen after atropinization, though its mode of physiologic action is different.

(5) Neither ephedrine nor atropine should be accepted as a specific diagnostic agent in the differentiation of an intrinsic lesion from an extrinsic one.

(6) Both of these drugs may relax spasm in the presence of local organic disease or may fail to relax spasm of a reflex or functional character.

(7) If it is desired to relax a stomach in order to study a questionable deformity more readily, ephedrinization has the obvious advantage over the use of atropine in that the former can be accomplished in a few minutes by the oral method, permitting the entire study to be finished at one examination.

(8) Great emphasis is placed, however, on the value of a second examination on a succeeding day in the study of spasm, since stomachs free of organic pathology rarely show the same spasm at a second examination.

(9) These drugs are not effective in the relaxation of cardiospasm, and their action in cases of pylorospasm is variable.

ROE J. MAIER, M.D.